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INDUSTRIAL ELECTROCHEMISTRY AND ELECTROMETALLURGY.

On another page of this issue will be found the first section of a second series of notes prepared by Mr. John B. C. Kershaw and dealing with recent progress in the industrial application of electrochemical and electrometallurgical processes. The author has exceptional facilities for keeping in touch with the conditions prevailing in the older processes and for getting early and reliable information relating to newer methods and installations. The notes will doubtless be appreciated by all interested in these lines of work. The first series of these notes appeared in the ELECTRICAL REVIEW, January to April, 1903.

CONSERVATISM DESIRABLE IN ELECTRICAL APPLICATIONS.

In applying electrical methods to old processes or to new, the inventor too often attempts too much. Instead of being satisfied to make a change in one stage of the process and perfect that before passing to the next, he seeks to revise the whole process —too often without complete success. If, on the other hand, he would make use of electrical energy for that stage of the process where it can be used to the best advantage, the success attained at this point would indicate whether it were worth while to carry the development further, and the experience gained would be most helpful in new work. Moreover, the inventor's whole attention could be devoted to that one stage, and he should make better progress in this way than if he were attempting to change the entire process at once.

Limitations of Electrical Methods Overlooked.

The limitations of electrical methods are too often overlooked in electrometallurgical processes. Since electrical energy can be transmitted easily, handled conveniently, and may be used to produce extremely high temperatures, it seems very suitable for furnace operations; but in this application highly developed metallurgical processes must be contended with, and it becomes a question whether the additional cost of the heat produced electrically, as compared with that produced directly from fuel, can be compensated for by the reduction in the cost at other points. Where only moderately high temperatures are desired, and the use of coal or gas is, in itself, not objectionable, there seems to be little reason for attempting to supply this heat electrically, as to do so would simply add to the cost and perhaps bring about failure. Thus, in reducing metals in the electric furnace, where a high temperature is desirable to bring about the reduction, it would seem advisable at first to limit the application of electricity to this one point only, such other heating as is required being brought about by other means. Or, as another illustration, in making glass in an electric furnace, after fusing the raw material it must be kept in a molten condition for about twenty-four hours, so as to allow all entrapped air to escape and the molten mass to become transparent; but to maintain a large mass of glass in a molten condition for twenty-four hours with electrical energy, would most certainly make the process too expensive to be commercial.

The Ruling Factor.

There are, of course, cases where questions of safety and convenience are all important, and considerations of cost are secondary; but such cases are not very frequently met in commercial processes. In these, cost is generally the ruling factor, and this should never be overlooked. Let electrical means be applied first wherever they can reduce cost, or where other means

will not suffice, and other applications will follow later. It is no disgrace to retain, in certain stages of an electrical process, older methods which have proved to be economical.

THE CONVENTION OF THE INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION.

The annual convention of the Interstate Independent Telephone Association will be held in Chicago, Ill., December 8, 9 and 10. Of course, every one knows of the attractiveness and convenience of that city, as a convention headquarters, particularly as concerning telephone men. A large part of the manufacturing element has permanent establishments in Chicago and this element has always been a prominent factor in conventions of independent telephone associations, and particularly so with regard to the Interstate Independent Telephone Association. The convention in 1904 is pledged to St. Louis, Mo., and no doubt the manufacturers will be strongly in evidence this year at Chicago.

Another Successful Session.

The association is one of the youngest of the independent telephone organizations, having been inaugurated in April, 1902. Notwithstanding, it is a strong body, and thoroughly representative of the independent movement, embracing a large portion of the entire investment in this industry. Its two former sessions have been marked by an enthusiasm and completeness that have almost paralleled the affairs of the national body and the present indications are that the third general gathering will not fall short, in point of attendance and interest, of those that have gone before.

The Programme.

The published programme anticipates an address of welcome by the mayor of the municipality. Inasmuch as Chicago is about to make an elaborate experiment in independent operations and under a system involving radical differences from existing installations, there is an excellent opportunity here for something different from the stereotyped form of generalities and offering of the city privileges, etc. Mayor Harrison is presumed to be an antagonist of monopolies and has recently gone on record as declaring vigorously in favor of a municipal lighting plant. It would therefore be refreshing to hear some matter-of-fact opinion on this subject from this source. The present executive of the association, Senator C. E. Hull, is well equipped and will no doubt have a message of importance to convey to his listeners. At the last meeting the secretary, Mr. E. M. Coleman, offered some valuable suggestions as to unifying the work and establishing a firmer foundation of organization. His ideas on clearing-house methods and census-taking are particularly debatable and should receive a great deal of attention. There is a lamentable lack of accessible information with regard to independent statistics, and this should be remedied at once.

Statistics Hard to Gather.

Of course, any one who has watched the development can appreciate the apparent difficulty which the compilation of such data would entail. But a start should be made. The members of such associations are in possession of the facts and should encourage all legitimate efforts to construct accurate tables of information.

Growth More Stable than Hitherto.

Apropos of the compilation of comparative data, this should be easier as time goes on, as each year is seeing a decrease in the mushroom growth of independent exchanges. This does not mean that the movement is suffering any retardation, but rather that it is attracting slow-moving, careful investors and is losing all semblance of wildcat venturing. This is as it should be, for it matters little to the subscriber, after all, who gives him service, as long as it is given conscientiously. Members of the Interstate Independent Telephone Association can be of great help one to the other only when they make their every effort toward a betterment of conditions where they can be improved, and then impart freely and fully the methods employed in doing so.

ELECTROLYTIC DRILLING.

In a brief article contributed to the October issue of the *Electrochemist and Metallurgist,* Mr. Sherrard Cowper-Coles describes an electrolytic method of drilling and slotting metals, which is an interesting application of electrolytic action as an aid to the machinist. In this method, the metal to be drilled is made the anode of an electrolytic cell, any other suitable material serving for the cathode. A heavy current is then passed from the plate to the cathode through any convenient electrolyte, the effect, of course, being to dissolve metal from the cathode. In order to limit the action of the current to the section to be removed, the anode is covered with a soft rubber washer having an opening of the size and shape of the hole to be cut. In the apparatus, as devised, the electrolyte is confined in a vulcanite tube and, being rapidly circulated, prevents treeing of the deposited metal on the cathode, as this might cause a short-circuit. If a slot is desired, it is only necessary to move the apparatus over the metal where the cut is to be made.

The Method Has Advantages.

While this method will not give results as exact as drilling and slotting with a tool, it would seem suitable for a number of operations, and, although the electrolytic drilling proceeds slowly as compared with machine drilling, the method may be used without previous treatment of the metal. A hardened steel armor plate would be no more trouble to drill than a similar plate of soft steel. The work can proceed under water, possibly with advantage in some instances. While it is true a heavy current density would be necessary to carry on the work satisfactorily, the power required need not be large, as the voltage may be low. After the apparatus is set to work, it should not require much attention, and one man would certainly be able to take care of a good number of such drills. Thus, as the work can be carried on at a number of points simultaneously, the slowness with which the drilling proceeds at any one point would be, to a large extent, compensated for.

THE MAGNETIC EFFECT OF ELECTRIC CONVECTION.

According to the views held by Faraday and Maxwell, the motion of a body electrically charged should produce a magnetic field, and a method was suggested by Maxwell for testing this, which was first carried out brilliantly by Rowland in 1876. The method consisted simply in revolving a charged ebonite disc in the vicinity of an astatic magnetic needle. Since the charge which the disc could carry was necessarily small, as compared with the quantities involved in current flow, and as the velocity of the disc was also small compared with that of light, the deflections expected, even with the most delicate apparatus, could be but small. Rowland's results, however, satisfied Helmholtz, in whose laboratory the work was done.

A Modified Method.

Later an attempt was made by Lecher to repeat the work, but without success, though Rœntgen, in one of his experiments, did observe a similar effect. In 1897 Crémieu undertook to investigate the subject by another method. If a moving charge sets up a magnetic field, a varying magnetic field, he argued, should exert a mechanical force upon a stationary electric charge. He was, however, unable to detect any such effect. He then modified his experiment, in this way: he replaced the varying magnetic field by a varying electric field, set up by rapidly charging and discharging a disc, and he sought for an electric current induced in a coil of wire placed parallel to the charged surface. This action should set up a varying magnetic field if the Faraday-Maxwell theory be true, and such a reaction could readily be detected by a coil placed parallel to the disc and connected to a galvanometer through a suitable commutator. The work was most carefully carried out but gave only negative results.

Rowland's Work Verified.

To disprove or verify Crémieu's work, Pender, working under Rowland, adopted Crémieu's apparatus and obtained decidedly positive results. He was even able from his data to calculate approximately the velocity of light, while Crémieu continued to obtain his negative results. To settle the matter, Pender was invited to repeat his work at Paris, in conjunction with Crémieu, and he here verified his former result. Pender obtained deflections with his galvanometer; Crémieu, none. However, by adopting Rowland's apparatus, Crémieu was convinced, though he was unable to account for his failures with his own apparatus. It was then noticed that he had covered the conducting surface of the plates which he charged with a dielectric. Upon repeating the work without this coating, he succeeded in obtaining the long-sought deflection.

What Effect Has the Dielectric?

This work disposes of the last doubt thrown on Rowland's work, but it has brought up an interesting question of the action of the dielectric. Vasilesco-Karpen attempted to answer this question, and modifying Crémieu's arrangement so as to intensify the effect by means of a condenser and by revolving the charged disc he obtained deflections when the charged disc was covered with various dielectrics, indicating that a magnetic field is set up in any case. This result is not in agreement with the observations of Crémieu and Pender, which remain unexplained.

POWER FOR LIGHTING CARS.

When electric lighting of cars was first suggested, the objection was doubtless raised against it by many, that to force the locomotive to furnish the additional power required by the lamps would be only throwing more work on an already overloaded machine. This is true, but the amount of power required to light a car is comparatively so small that that taken by a long train would hardly be felt by the large locomotives which are now in use. The steam locomotive for a heavy train would probably be rated at 1,000 horse-power, and it would be working at about its full output when running at a good speed. The lighting equipment of a Pullman car consists of about eighty eight-candle-power incandescent lamps. For such application only high-efficiency lamps would be used, so that the power consumed by each lamp would be small. In fact, two kilowatts per car would probably be sufficient to supply all the lights on the car. This, allowing for losses, would be about five horse-power at the axle, and would amount to only 0.5 per cent of the rating of the locomotive required by each car. It is highly probable that the car resistance itself during a run may vary so as to masque entirely the demands made by the lighting system, and the effect on the speed of the train would not be appreciable.

HELIUM AND RADIUM.

In a recent lecture before the London Institution, Sir William Ramsay, professor of chemistry at University College, London, made the interesting announcement that his experiments seemed to verify the suggestion, made some time since by Rutherford and Soddy, that during the so-called disintegration of radium, helium is formed. It will be remembered that Rutherford and Soddy showed that an emanation having the characteristics of a heavy gas which could be collected was given off by radium. This emanation seemed to undergo a change or disintegration, but some final product must remain, and this they suggested might be helium.

Spectrum of Helium Found.

Sir William Ramsay, in his work, collected the emanation of radium and examined it for helium. This was first detected by its spectrum, after the emanation had been kept for a couple of days, the characteristic lines of helium becoming brighter thereafter from day to day. The observation agrees with the deductions drawn from the recent work of Rutherford and Barnes, in measuring the heat given off by radium. They found that the heat given off by the emanation increased to a maximum after separation from the radium salt, an effect which was attributed to a second stage of disintegration, corresponding to that stage during which helium apparently is formed.

Evidence from the Chemist's Side Desirable.

The physicists seem to be making out a good case for their new ideas of the nature of atoms, but the evidence is not all in yet, and the theory can hardly be called proved. Some evidence upholding the chemist's atomic theory would be very interesting at the present time, particularly in regard to radioactive substances.

THE MISUSE OF PHYSICS BY BIOLOGISTS AND ENGINEERS.[1]

BY W. S. FRANKLIN.

My chief object in presenting this paper is to call attention to some of the precise notions of thermodynamics and to point out the essential limitations of that subject.

A great deal is, I think, to be gained for science at the present time by insisting upon the sharp delimitation of those general ideas in physics which are related primarily to thermodynamics just as a great deal has been gained in the last half century by the sharp delimitation of those general ideas which relate primarily to mechanics. There is, I think, a widespread confusion of boundaries which makes this sharp delimitation a thing greatly to be desired, and I have chosen as the title of this preliminary paper "The Misuse of Physics by Biologists and Engineers" for the reason that, in my opinion, these men, more than any others, violate in their philosophy the essential limitations of systematic physics and confuse the boundaries between systematic physics and statistical physics.

Physics is divided into two branches, namely, systematic physics and statistical physics.

Systematic physics is again divided into mechanics and thermodynamics.

Mechanics, in the broad sense here defined, treats of those phenomena which can be to a high degree of approximation correlated in one-to-one correspondences to states of equilibrium and to simple types of sensible motion.

Thermodynamics treats of those phenomena which can be to a high degree of approximation correlated in one-to-one correspondences to states and processes involving thermal equilibrium and involving those permanently varying states which I have called steady sweeps.

Statistical physics is the study of all the actual physical phenomena of nature, some of which, indeed, may be described in terms of the notions of ideal mechanics to a high degree of approximation, and some of which, indeed, may be described in terms of the notions of ideal thermodynamics to a high degree of approximation, but all of which are more or less erratic and in their minute details infinitely manifold, and in all of which the notion of one-to-one correspondence or of cause and effect, if one prefers that mode of expression, fails.

[1] Abstract of a paper read before the American Physical Society on October 31, 1908.

The engineer is not far wrong in his application of the principles of mechanics, for the engineer is chiefly concerned with integral relationship between finite things.

In studies which require the application of the principles of thermodynamics, on the other hand, engineers are, I think, frequently in error.

The biologist is, I think, usually illogical when he attempts to make use of the ideas of systematic physics.

The biologist and the engineer need to have precise knowledge of themodynamics, inasmuch as it is thermodynamics chiefly which determines the limits of correct application of the ideas and methods of systematic physics to natural phenomena.

I—THERMAL EQUILIBRIUM.

When a substance is shielded from outside disturbance it settles to a state in which there is no tendency to further change of any kind. Such a state is called a state of thermal equilibrium.

When a substance has settled to thermal equilibrium it is said to have a definite temperature. The notion of temperature, that is the precise idea of temperature, as a physical fact is derived from the notion of thermal equilibrium. Also the idea of differences of temperature as physical facts (not as quantities) is derived from comparisons of states of thermal equilibrium.

II—REVERSIBLE PROCESSES.

A substance in thermal equilibrium is generally under the influence of external agencies. However, a substance can not be in thermal equilibrium when work is continually done upon or done by it, or when heat is continually given to or taken from it.

If the external influences which act upon a fluid in thermal equilibrium are made to change very slowly, causing the pressure and volume of the fluid to pass very slowly through a continuous series of valves, and in general involving the doing of work upon or by the fluid and the giving of heat to or taking of heat from the fluid, the fluid will pass slowly through a process consisting of a continuous series of states of thermal equilibrium. Such a process is called a reversible process, for the reason that the fluid will pass through the same series of states in reverse order if the external influences are changed slowly so as to make the pressure and volume of the fluid pass through the same series of values in reverse order.

The characteristics of a reversible process are therefore as follows:

(*a*) A substance which undergoes a reversible process must be under varying external influence. A closed system can not perform a reversible process.

(*b*) A substance as it undergoes a reversible process is at each instant in a state of thermal equilibrium.

(*c*) A reversible process must take place slowly, strictly with infinite slowness. An actual process, that is, a process which actually does proceed, can be only approximately reversible.

III—SWEEPING OR IRREVERSIBLE PROCESSES.

While a substance is settling or tending to settle to thermal equilibrium it may be said to undergo a process. Such a process can not, in general, be arrested and maintained at any stage short of complete thermal equilibrium, but always and inevitably proceeds toward that state. Such a process is, therefore, called a sweeping process or simply a sweep.

A sweeping process takes place in one direction only, that is, if A and B are two successive stages of a sweep, stage B following stage A, then stage B grows out of stage A inevitably, but stage A can not be made to follow or grow out of stage B by any means whatever. A sweeping process, therefore, is reversible.

Note 1—A fluid not in thermal equilibrium has no definite pressure, temperature or volume. The volume of a turbulent gas pertains only to the containing-vessel. Points in Watt's diagram can represent only states of equilibrium, and lines in Watt's diagram can represent only reversible processes.

Note 2—Writers on thermodynamics who are obliged to deal with irreversible processes or sweeping processes, that is to say, steam engineers, frequently introduce the notion of the integration of entropy and temperature. Now in the first place, when this method appears to give results a legitimate mode of calculating sweeps is really used, and the legitimate ideas involved are illogically expressed in terms of temperature and entropy. In the second place, temperature and entropy have no meaning as applied to the elements of volume, even of a substance in thermal equilibrium, not to mention the question of their application to the volume elements of a turbulent substance.

IV—SIMPLE SWEEPS.

The settling of a closed system to thermal equilibrium is called a simple sweep.

Example—The equilibrium of a mixture of oxygen and hydrogen in a closed vessel may be disturbed by a minute spark, and the explosion and subsequent settling of

the aqueous vapor to a quiescent state without loss of heat constitute a simple sweep.

V—TRAILING SWEEPS.

When external influences change continuously, a substance in its tendency to settle to equilibrium never catches up, as it were, with the changing conditions, but trails along behind them, and we have what is called a trailing sweep.

Examples—The rapid expansion or compression of a gas in a cylinder is a trailing sweep. So long as the piston moves at a perceptible speed, the gas, in its tendency to settle to equilibrium, never catches up with the varying conditions.

VI—STEADY SWEEPS.

A substance may be subjected to external action which, although unvarying, is incompatible with thermal equilibrium. When such is the case the substance settles to a permanent or unvarying state which is not a state of thermal equilibrium. Such a state of a substance is called a steady sweep.

Examples—The two faces of a slab or the two ends of a wire may be kept permanently at different temperatures. When this is done the slab or wire settles to an unvarying state which is by no means a state of thermal equilibrium. Heat flows through the slab or along the wire from the region of high temperature to the region of low temperature, never from the region of low temperature to the region of high temperature. This flow of heat through the slab or along the wire is an irreversible process and it constitutes a steady sweep.

The notion of steady sweeps is of the utmost importance in thermodynamics, inasmuch as the thermodynamics treats directly of states of thermal equilibrium and of steady sweeps only.

The notion of entropy is involved in the notion of a steady sweep; and the notion of temperature is involved in the notion of thermal equilibrium.

VII—THERMODYNAMIC DEGENERATION AND REGENERATION.

A sweeping process always plays a certain havoc, or effects a certain degeneration in a system.

In a simple sweep the degeneration lies wholly in the relation between the initial and final states of the substance which undergoes the sweep, inasmuch as, in a simple sweep, no outside substance is affected in any way, no work is done on or by the substance which undergoes the sweep, and no heat is given to or taken from it.

In a trailing sweep the degeneration may lie partly in the relation between the initial and final states of the substance which undergoes the sweep, partly in the direct conversion of work into heat and partly in the direct transfer of heat from regions of high temperature to regions of low temperature.

In a steady sweep the substance which undergoes the sweep remains entirely unchanged as the sweep proceeds, and the degeneration lies wholly in the direct conversion of work into heat, in the direct transfer of heat from a region of high temperature to a region of low temperature, or both.

A substance which has undergone a sweeping process may be brought back to its initial state, or regenerated, by a reversible process; but when a substance is regenerated by a reversible process, the external action necessary to bring about the reversible process involves an equal degeneration of some external substance; that is, the regeneration of a substance by a reversible process always involves the creation of an equal external regeneration. This is, in fact, a statement of the second law of thermodynamics.

The following two propositions concerning the two kinds of thermodynamics degeneration (*a*) and (*b*) follow at once from a consideration of steady sweeps.

Proposition (A)—The thermodynamic degeneration represented by the direct conversion of work into heat at a given temperature is proportional to the quantity of work so converted.

Proof—Consider a steady flow of electric current in a wire. This process being steady, the amount of degeneration occurring in a given interval of time must be proportional to the time. The amount of work converted into heat is also proportional to the time. Therefore the amount of degeneration is proportional to the amount of work converted into heat. Of course the temperature must be invariable, or the process can not be thought of as remaining identically the same from instant to instant.

Corollary—The thermodynamic regeneration which is represented by the conversion of heat at a given temperature into work by a reversible process is proportional to the heat so converted.

Proposition (B)—The thermodynamic degeneration represented by the direct transfer of heat from a given high temperature T_1 to a given low temperature T_2 is proportional to the quantity of heat transferred.

Proof—Consider a steady flow of heat from temperature T_1 to temperature T_2 constituting a steady sweep. This process being steady, the degeneration occurring in a given interval of time must be proportional to the time. The quantity of heat transferred is also proportional to the time. Therefore, the amount of degeneration is proportional to the quantity of heat transferred.

Corollary—The thermodynamic regeneration which is represented by the transfer of heat from a low temperature T_2 to a high temperature T_1 by a reversible process is proportional to the heat transferred.

VIII—THE SECOND LAW OF THERMODYNAMICS.

(*a*) The degeneration of a system which accompanies a sweeping process can not be directly repaired, nor can it be repaired by any means without the creation of a compensating degeneration in some other system.

(*b*) Heat can not pass directly from a cold body to a hot body, nor can heat be transferred from a cold body to a hot body by any means without compensation.

(*c*) Heat can not be converted directly into work, nor can heat be converted into work by any means without compensation.

(*d*) A gas can not pass directly from a region of low pressure to a region of high pressure, nor can a gas be transferred from a region of low pressure to a region of high pressure by any means without compensation.

IX—ENGINES.

The further development of the subject of thermodynamics depends upon the establishment of the exact relation between the degeneration which is represented by the transfer of heat from a high to a low temperature and the degeneration which is represented by the conversion of work into heat. To establish this relation it is necessary to consider a reversible process in which the degeneration of heat from high to low temperature is compensated by the regeneration of heat into work, or *vice versa*.

The engine is a machine which determines such a process. The ordinary engine, indeed, is subject to friction, and the steam as it passes through the engine does not undergo a reversible process; but if the engine were frictionless, if it were driven slowly, if the cylinder were prevented from cooling the steam, if the steam were expanded sufficiently to prevent puffing and if the feed water were heated, in a "regenerative" feed water, to

boiler temperature before entering the boiler, then the processes involved in the operation of the engine would be reversible. Such an ideal engine we will call a reversible engine or a perfect engine.

During a given interval of time the engine takes an amount of heat H_1 from the boiler at temperature T_1, it converts into work W a certain fractional part of H_1 and delivers the remainder H_2 to the condenser at temperature T_2.

The work W done by the engine is equal to the difference $H_1 - H_2$ according to the first law of thermodynamics. That is.

$$W = H_1 - H_2. \qquad (1)$$

Now, all the heat used in the engine comes from the region at temperature T_1, and the net result of the operation of the engine is: (*a*) to convert the quantity $W\ (=H_1 - H_2)$ of heat from temperature T_1 into work, and (*b*) to transfer the quantity H_2 of heat from temperature T_1 to temperature T_2. The result (*a*) involves an amount of regeneration which is proportional to W, temperature being given; this regeneration may, therefore, be represented by mW where m is a constant depending only on the temperature T_1. The result (*b*) involves an amount of degeneration which is proportional to H_2, temperatures being given; this degeneration may, therefore, be represented by nH_2 where n is a constant depending only on the temperatures T_1 and T_2. If the engine is reversible we must have

$$mW = nH_2, \qquad (2)a$$

or, using the value $(H_1 - W)$ for H_2, and solving for W we have

$$W = \frac{n}{m+n} H_1, \qquad (2)b$$

in which $n/(m+n)$ depends on T_1 and T_2, only, irrespective of the kind of engine and of the physical properties of the fluid employed in the engine, provided, only, that the engine is reversible. The fractional part $n/(m+n)$ of the heat H_1 which the engine converts into work is called the efficiency of the engine, and from equation (2) *b* it follows that the efficiency of all reversible engines is the same for given valves of the temperatures T_1 and T_2.

If the operation of the engine involves sweeping processes of any kind then the degeneration nH_2 exceeds the regeneration mW or

$$mW < nH_2,$$

or, using the value $(H_1 - W)$ for H_2, and solving for W we have

$$W < \frac{n}{m+n} H_1, \qquad (3)$$

in which m and n have the same values as in equation (1). Comparing this with equation (2) *b* it follows that any irreversible engine working between given temperatures T_1 and T_2, has less efficiency than a reversible engine working between the same temperatures.

X—THERMODYNAMIC DEFINITION OF THE RATIO OF TWO TEMPERATURES.

According to article 9 the ratio, H_1/H_2, of the heat taken from the boiler to the heat given to the condenser by any reversible engine working between the given temperatures T_1 and T_2 is invariable, and it can be easily shown that this ratio approaches unity as T_1 and T_2 approach equality. Therefore, the ratio of the two temperatures T_1/T_2 may be defined as the ratio of the two heats H_1/H_2. That is:

$$\frac{T_1}{T_2} = \frac{H_1}{H_2}. \qquad (4)$$

XI—ENTROPY. THERMODYNAMIC DEGENERATION.

The statement of the second law of thermodynamics can scarcely be looked upon as complete until a precise and complete numerical measure of thermodynamic degeneration has been established. This numerical measure of thermodynamic degeneration is called entropy. The notion of entropy may be completely developed by consideration of steady sweeps.

Referring to article 9 we may write the expression for the regeneration mW in the form $f(T_1) \cdot W$ inasmuch as m is a function of T_1 only.

The degeneration nH_2 may be written

$$[f(T_2) - f(T_1)]\, H_2,$$

inasmuch as the degeneration associated with the transfer of the heat H_2 from T_1 to T_2 may be thought of as (*a*) the regeneration of H_2 from temperature T_1 to work, and (*b*) the degeneration of this resulting work to heat at temperature T_2; in which case the regeneration (*a*) is $f(T_1) \cdot H_2$ and the degeneration (*b*) is $f(T_2) \cdot H_2$.

Therefore, equation (2) *a* may be written

$$f(T_1) \cdot W = [f(T_2) - f(T_1)]\, H_2.$$

Using equation (1) and equation (4) we have

$$\frac{f(T_2) - f(T_1)}{f(T_1)} = \frac{T_1 - T_2}{T_2}.$$

From which the function f is to be determined. Differentiating with respect to T_2 we have

$$\frac{f'(T_2)}{f(T_1)} = -\frac{T_1}{T_2^2} = -\frac{\frac{1}{T_2^2}}{\frac{1}{T_1}};$$

add, therefore, since T_1 and T_2 are independent of each other we have

$$f(T_1) = \frac{1}{T_1}.$$

That is to say, the thermodynamic degeneration associated with the conversion of an amount of work W into heat at temperature T_1 is equal to W/T_1, and the thermodynamic degeneration associated with the transfer of an amount of heat H_2 from temperature T_1 to temperature T_2 is

$$\frac{H_2}{T_2} - \frac{H_2}{T_1}$$

Absolute Values of Entropy—Entropy changes or entropy differences only have real physical significance. However, a certain state of a substance may be arbitrarily chosen as a zero state or reference state.

XII—SUMMARY.

The precise idea of temperature is associated with the notion of thermal equilibrium, and the precise idea of temperature has nothing to do with the sensations of hot and cold. The electric arc, for example, is very hot, but it has no temperature.

Not only is the precise idea of temperature limited to substances in thermal equilibrium, but it applies only to a finite portion of a substance. It is meaningless to speak of the temperature of a molecule.

There are many cases of steady sweeps, such as thermal conduction in a gas, steady radiation from a hot to a cold region, in which the sweeping substance, be it material or ether, is far from being in thermal equilibrium, although in a permanent or unvarying state. The precise idea of temperature is not applicable to such states.

In general, all cases of molecular motion and of ether motion (radiant heat) in which some definite and unvarying function exists expressing the distribution of energy among the various phases of the motion, are to be classed as steady sweeps. In all such cases the precise idea of temperature is inapplicable to the sweeping substance or space. Still, all such processes are amenable to precise and systematic treatment. This systematic treatment always depends upon a knowledge of the function of distribution of energy among the phases, and the characteristics of the sweeping substance or space are properly described in terms of this function, not in terms of temperature and entropy. It is true, however, that a generalized idea of entropy, for example, can be applied to steadily sweeping substances.

Entropy always increases in natural phenomena, and the notion of entropy is, perhaps, much more intimately related to the notion of time than any other physical notion whatever. The notion of entropy seems to me, indeed, to be the very foundation of the notion of time as a physical fact, although the numerical evaluation of time depends, in practice, upon the approximate realization of some of the precise ideas of mechanics.

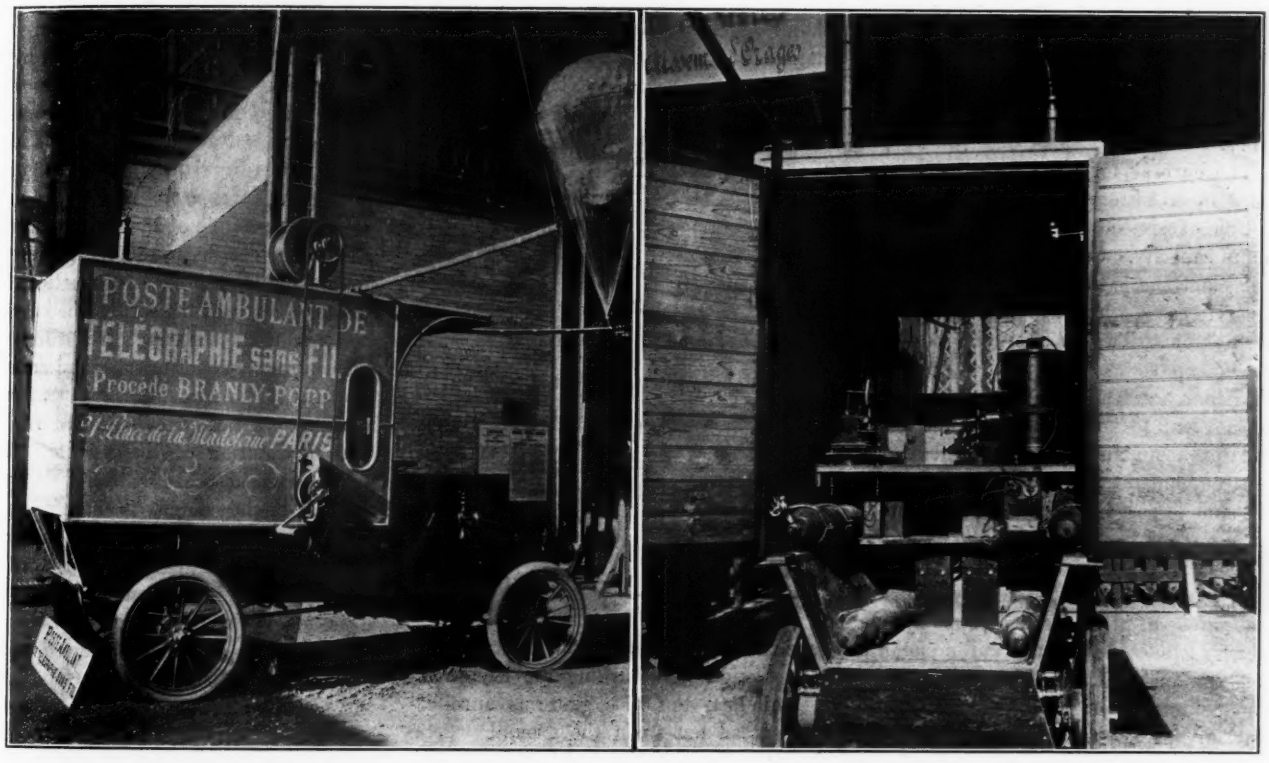
Heretofore the idea of the increase of entropy associated with a sweeping process has been thought by the ablest writers on thermodynamics to be dependent upon the devising of a reversible process which leads to the same change of state as the given irreversible process. This is, I think, true in regard to sweeping processes in general, but it is not true in regard to steady sweeps.

Electrical Notes from Europe.

An Automatic Wireless Telegraph Post, and the New Blondel-Carpentier Hysteresimeter.

(By Our Special Correspondent.)

ONE of the novelties in wireless telegraphy is the automobile post which has been brought out by the Société Française des Telegraphes Sans Fil, of Paris, which controls the Branly-Popp aerial telegraphy system. The apparatus is mounted in a large automobile somewhat on the line of a delivery wagon, the interior of which has been fitted up as a traveling station. The automobile can travel quickly to the desired point and is then stopped, the mast-wire carried up by a balloon or kite and the post is ready to communicate with another station. Such a system will no doubt find a variety of uses, and is especially valuable for military work. One of the engravings shows the automobile post complete and in the second will be observed the arrangement of the apparatus in the interior.



THE AUTOMATIC WIRELESS TELEGRAPH POST, SHOWING RAISING BALLOON AND INTERIOR APPARATUS.

Access is given to the inside by opening up two large doors and letting down a flap at the bottom. The main part of the interior, which contains the instruments and different apparatus, is partitioned off from the front, containing the driver's seat and a place for the telegraph operator. In the interior will be observed the main transmitting and receiving apparatus of the post, which is placed on a shelf or table about three by four feet. To the right is the apparatus for the transmission, with the receiving apparatus on the left. Below the main table is a second shelf which contains different apparatus, while the remainder, including the two accumulator boxes, is placed on the floor of the vehicle. The four hydrogen tubes for filling the balloon are attached against the sides and floor by iron straps.

As the apparatus is subject to considerable shocks from the movement of the automobile, special attention had to be paid to getting rid of the vibration as much as possible. The automobile body, in the first place, is given an extra spring suspension from the truck. The relay and receiving apparatus, which are the most sensitive, are mounted together upon a base which is then held upon the table by a spring suspension at the four corners, as may be distinguished in the engraving. This method of suspension has proved to be very effective in taking up the shocks, and no trouble has been experienced in practice from this cause.

The mast wire is rolled on a wooden drum of twenty centimetres diameter, which is mounted on the roof of the automobile, as the engraving shows. The drum is operated by a windlass which is mounted against the side of the car by means of a chain and sprocket-wheels. A band-brake upon the drum serves to regulate the feeding out of the wire. The drum can be blocked in position by a ratchet-wheel. The mast wire is carried by a kite of the cubical pattern, in case there is sufficient wind; if not, the wire is raised by small balloons which are carried on the car (one will be noticed on the right) and can be filled out with hydrogen from the tubes. In certain cases it may be impossible to use either kite or balloons, and to provide for this the automobile has been equipped with a mast of bamboo which is made in sections and can be quickly set up in place or taken down. The mast is braced upright by a set of bamboo poles which are fastened down upon the roof, as will be observed, and the ends of these pieces carry the stay wires which pass up to the top of the mast. In this way it is firmly held in position.

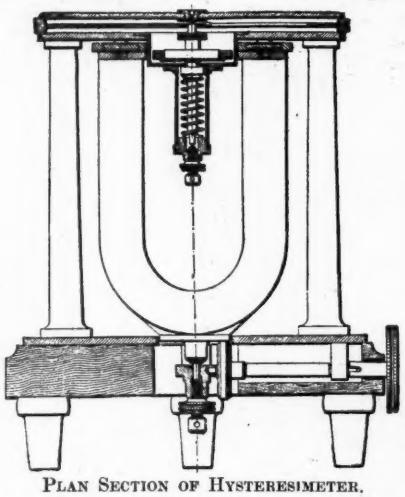
The automobile is of the gasoline type and is operated by a two-cylinder petrol

motor with electric ignition. The motor has a normal capacity of twelve horse-power. The weight of the automobile when completely equipped is about 2,850 pounds, including the two men in service. It can make an average speed of twenty-five miles an hour. The setting up of the wireless telegraphy post is easily carried out and can be effected by two men. When the automobile arrives at its destination one of the men unrolls the wire gauge sheet which forms the ground connection (noticed on the side of the vehicle) and spreads it on the ground. The second man fills out the balloon from the hydrogen tubes or mounts the kite, attaches the mast wire and unrolls the drum. Experiments show that the post can be set up and ready to send messages within ten minutes. As to the distance which the automobile post will cover, this varies from thirty to fifty miles for land communication. On the sea, from the shore to vessels it can cover nearly 100 miles.

The current for the apparatus is supplied by a battery of accumulators consisting of sixteen cells of sixty ampere-hours capacity. Celluloid is used for the cells, and the battery is mounted in two separate cases, which are stored below the main table. Two of the cells are connected up so as to supply current for the Morse receiver. The current capacity is sufficient to keep the apparatus working for about thirty hours. The transmitting apparatus which is used in the automobile post includes an induction coil giving a twenty-centimetre spark, with its condenser and vibrating contact-breaker; with the coil is used the new syntonizing apparatus of the Branly-Popp system which includes a condenser, an inductance coil and an oscillator. The contact-key for making the signals has a magnetic blowout for suppressing the spark.

The essential feature of the receiving apparatus is the new coherer which has recently been invented by Dr. Branly. The principle of this coherer has already been described and illustrated in the ELECTRICAL REVIEW. As will be remembered, the coherer is formed of a small metallic tripod which rests upon a polished steel disc, and the cohering action takes place between the points of the tripod and the disc. The whole is mounted upon the Morse receiver in such manner that the tapping arm of the instrument gives the shock which is needed for the decohering action, so that an independent striker is not needed, which simplifies the apparatus considerably. The Morse receiver, with its coherer, is provided with a sensitive relay of the Claude pattern, which works on half a volt, and also a syntonizing coil. A telephone can also be connected in the circuit to replace the Morse receiver if need be, and it is especially useful in carrying out the syntonization.

A hard drawn copper wire of 0.7 millimetre is used for the mast-wire; it is 500 metres long. To mount the wire, four balloons are provided. Two of the balloons have a capacity of two cubic metres, while the other two have but half that capacity. The larger balloons are used for mounting the wire to a great height when it is to be used for long-distance transmission. Each of the steel cylinders containing the hydrogen for the balloons carries 7,000 litres of hydrogen compressed at 150 atmospheres. A double-throw switch places the mast-wire upon either the transmitting or the receiving circuit. The ground connection is formed by a sheet of copper gauze ten metres long and eighty centimetres wide. By turning the handle of the windlass the wire gauze is unrolled and spread out upon the ground, where the numerous contacts with the soil are sufficient to make a good earth connection.



PLAN SECTION OF HYSTERESIMETER.

The new instrument which has been devised by Professor Blondel and constructed at the Carpentier establishment of Paris affords a very convenient method of determining the hysteresis coefficient of a given sample of iron by a single reading. It is intended to be used in industrial work. As the knowledge of the hysteresis value is of such importance in selecting iron for building electrical apparatus, there is no doubt of the practical utility and time-saving of such an instrument. The instrument measures the hysteresis coefficient η which characterizes a given iron, by a comparative method, using for the purpose a standard sample whose coefficient has been previously obtained.

The main part of the hysteresimeter consists of a permanent magnet of U-shape which is placed vertically and rotates around a central shaft. The magnet is caused to turn by a hand-wheel or large thumb-screw which acts upon the main shaft. The test-piece has the form of a ring which is built up of a series of rings cut out of the iron to be tested and pressed tightly together. The ring is placed flatwise between the branches of the magnet upon a support which is mounted upon pivots and can revolve about a vertical axis which coincides with that of the magnet.

When the magnet revolves, the flux which is produced in the ring is caused to shift within the mass, and the phenomenon of hysteresis is manifested by an effect which is quite analogous to that of friction. On account of this friction, the test-ring is drawn along with the magnet and tends to revolve. It works against a spring and turns around the centre until the opposing couple of the spring becomes equal to the couple due to the hysteresis. As the opposing couple is proportional to the torsion angle of the spring, the angular deflection of the test-ring gives a number which is proportional to the couple due to hysteresis. Experiment shows that this couple is practically independent of the speed of rotation of the magnet. The work which is absorbed by hysteresis (proportional to the couple) is therefore constant per revolution of the magnet and is measured by the angle which is read on the dial of the instrument.

The magnet which is placed in the apparatus has been constructed so as to produce an induction equal to 10,000 centimetre-gramme-second units. The air-gap which is allowed between the magnet and the test ring is such that the difference of permeability from one sample to another will be negligible, and in practice all the rings which are placed in the instrument take the same induction. Owing to this cause and on condition that the rings have always the same volume, the hysteresimeter allows of comparing different samples of iron with considerable exactness and to classify them as to the value of the hysteresis. To determine the value of the constant η for a given sample of iron, it suffices to compare it with a standard ring whose coefficient has been already determined by another method. In practice the magnet is revolved in one direction and the angle read; it is then turned in the opposite sense. The angle

between the two readings thus formed is double that which is observed for one direction. The reading is thus more exact, and any errors due to a previous magnetization of the iron is eliminated.

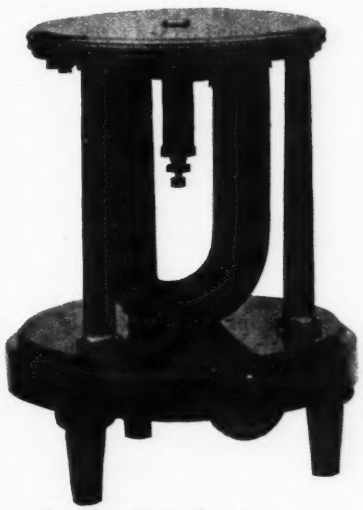
The apparatus is illustrated in the general view and in section. The horseshoe magnet with vertical branches rests upon a pivot at the lower end and is guided at the upper part by three rollers which are spaced around the circumference of a ring attached to the upper part of the magnet. This disposition allows of making the axis of rotation of the magnet coincide exactly with the geometric axis of the iron ring and so assure the uniform magnetization of the latter. The lower pivot is surmounted by a small disc lying just under the magnet, on which bears a leather-faced friction wheel which is turned by the milled wheel at the right-hand side. The iron ring to be tested is placed upon a brass supporting-plate which is fixed on the end of a vertical shaft. The shaft rests upon a pivot at the lower end and at the upper it is pivoted in a cap which is fixed in the glass cover of the apparatus. The ring which is thus mounted can revolve by turning the shaft, but the ensemble is held by a spring which will be observed. In order to prevent vibration which would be troublesome for the readings, the tube which contains the pivot, shaft and spring is filled with a thick oil whose viscosity is sufficient to make the instrument dead-beat. A needle is mounted on the shaft and it moves over a graduated scale which is placed on the glass cover of the instrument. By turning the cover around, the zero of the scale can be brought in line with the needle.

To test the iron by this method requires two operations, the preparation of the sample and the measurement. The iron ring which forms the sample should have fixed dimensions which correspond with the apparatus. Its thickness should be four millimetres, the exterior diameter fifty-five and the interior diameter thirty-eight millimetres. The sample thus prepared is placed upon the support of the apparatus by taking off the glass cover and removing the plate which serves to hold the ring. The sample is held in place by a pair of catches and is further fixed by a cross-pin. The whole is then put back into place.

To make the measurement, the milled wheel is turned at a speed which is sufficient to bring the needle to a steady position, say two or three revolutions per second. The glass cover and scale are then displaced with the other hand so as to bring the zero of the scale opposite the needle. The reading is taken and then the milled wheel is turned in the opposite direction and at the same speed. The needle is displaced and the deflection is read in degrees, say 250 degrees. If a reading has already been taken by using the standard sample in the instrument, the coefficient η of the sample being known and equal to 0.00200, for instance, and the reading of the instrument 275, the value for the sample under test will be

$$\eta = \frac{0.00200}{275} \times 250 = 0.001818$$

When the sample rings are cut out with care and the total number of rings is superior to four (which permits of neglecting completely the effect of Foucault currents) the apparatus gives results which are sufficiently exact and allows of



THE NEW BLONDEL-CARPENTIER HYSTERESIMETER.

obtaining the relative values of different samples of iron within five per cent, and more often within two per cent. This is quite sufficient in practice, seeing that the iron is not always homogeneous within these limits. It is to be noted that the results given by the apparatus show the hysteresis which is due to rotation, such as is produced when the direction of the flux is changed without altering its intensity; this is the effect which takes place in a dynamo. The coefficient of alternating hysteresis, which is developed in iron which is submitted to the action of a flux of constant direction (such as in transformers), seems to be somewhat smaller than the former.

The instrument as constructed at present is not likely to get out of order. The only changes that may occur with time are, first, that the magnet may become weakened. This cause of error has been rendered negligible by using only magnets which have been tested for duration and of good quality. Second, the coefficient of the sample ring may change. This phenomenon, known as ageing, is observed especially in iron which has a low hysteresis coefficient. On this account the sample ring is built of iron which has a coefficient of mean value and hence is not likely to change. Besides, the ring can be sent back to the constructor to be recalibrated, or this operation can be carried out from time to time by the well-known ballistic method.

The present instrument has the advantage of giving measurements which are sufficiently exact and at the same time can be carried out on an industrial scale; it is of solid and simple construction, and the readings are easily taken, the operation not requiring more than a minute. There is no doubt that it will effect a great saving of time in determining the quality of laminated iron for dynamos and transformers.

The Fourth Progress Report of the Committee on Photometric Value of Arc Lamps of the National Electric Light Association.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

In the abstract of the "Fourth Progress Report" of the committee on photometric values of arc lamps of the National Electric Light Association, an unfortunate clerical error appears in the matter of the relation of candle-power to voltage in the single-glower Nernst lamp. In the sentence, "A special test given in the report shows that a change of one per cent in the voltage makes in this particular case a change of more than fourteen per cent in the candle-power." Value should be 6.38 per cent.

CHARLES P. MATTHEWS,
Photometrist to the Committee.

Drainage by Electricity.

The London *Electrician* reports that the drainage board of the Birmingham, Tame and Rea district (England), acting upon the suggestion of its engineer, Mr. J. D. Watson, has decided to carry out an electrical power transmission scheme in connection with the drainage and sewage disposal system under its control. Electricity will be generated at Saltley, near Birmingham, by two 175-horse-power steam engines, each directly coupled to a three-phase dynamo generating current at 2,300 volts, fifty cycles. The current will be led by an overhead line five miles in length, and will be supplied to eight small substations along the route. At these stations step-down transformers will reduce the pressure to 200 volts. At four substations centrifugal pumps, directly connected to induction motors, are to be installed for the purpose of pumping water from the main culvert on to the land. Other motors will be used to drive machinery for the different farms situated on the board's estate, and the principal buildings will be lighted electrically.

130 MILES AN HOUR.

THE FAMOUS RUN ON THE HIGH-SPEED ELECTRIC ROAD FROM BERLIN TO ZOSSEN.

[*Dr. Reichel in a Berlin weekly, translated by the Scientific American.*]

All preparations have been made; a brake test has been carried out; the engineers have climbed into the car, and the military posts along the road have been informed that the car is soon to start. The motorman turns the controller very slowly through a few degrees. Fourteen thousand volts shoot from the lines to the motors. With a whirr the car starts on its memorable journey from Marienfelde at twenty-five minutes after nine o'clock. The overhead wires are swaying in a strong wind. As the car travels on, the strength of the electrical current fed to each of the four motors is gradually increased to 350 amperes. In other words, 2,300 kilowatts, or 2,600 mechanical horse-power, are being expended. A mile and a quarter has been covered. The speed indicator shows a velocity of seventy-five miles an hour. When Lichtenrade is reached, about half a mile further on, the car is rushing on at ninety-four and one-half miles an hour. Each second the speed increases. Just before the station of Mahlaw appears, a curve of 6,560 feet radius looms up. The speed is now one hundred and nine miles an hour. We seem to be leaping toward the curve. No bend can be seen; the track apparently ends abruptly. We know it is only a curve, and yet we are anxious; we brace ourselves for a shock. Just as we reach the curve the track seems to bend into a gentle arc into which the car runs easily.

The curve is passed. About a mile ahead of us a safety signal can be seen. We climb a grade of twenty-six feet to the mile—slight, to be sure, and yet to ascend it at full speed we must expend 300 horse-power more. The train is flying on faster and faster. We rush through Mahlow (four miles from Marienfelde) at a speed of 115 miles an hour. No vibration or shock is felt. It seems as if the car itself were not moving—as if buildings, poles, trees, were flickering past. Only the humming of the wheels assures us that it is we who are moving. The voltmeter shows that the current collectors are doing their work smoothly. No fear of increasing the speed need be felt. The last resistances of the controller are gradually cut out under the load of 2,300 kilowatts. The finger of the speed indicator slips along to a mark which shows that the car is making 121 miles an hour. At every crossing a loud ringing note can be heard, caused by the wheels.

Fragments of ballast as large as walnuts are sucked up into the air and fall back as the train rushes on. At first the speed is bewildering, almost stupefying. We in the cab are much nearer the track than is the engineer of a steam locomotive. On that account it seems at first as if the car is literally devouring the road by the mile. Gradually we become accustomed to the new sensation. The feeling of safety and comfort which overcomes the first shock of amazement gives rise to the desire to travel still faster. After the 120-mile-an-hour mark has been passed the excitement in the car becomes intense. Not a word is spoken. Only the click of the wheels over the rails is heard. Every eye that is not fastened on the speed indicator is glued on the track. Suddenly, at a distance of about half a mile, we see two men unconcernedly standing in the middle of the road calmly awaiting the car. The motorman jumps for the whistle string. As the danger signal shrieks, the two men on the track turn about with a frightened look, and then flee for their lives. No power can stop this ninety-three-ton car within a mile.

We whiz past the town of Dahlwitz. Dust, sand and large pebbles leap up behind us. We just catch a glimpse of people on the station throwing up their hats in joy. Suddenly a smashing blow is heard against the window of the cab, as if a man brought his fist heavily down upon a table. It was a bird, overtaken in its flight and killed. The speed indicator finger climbs up past the 124-mile mark. Rangsdorf is only one and one-quarter miles away (8.6 miles from Marienfelde). It is soon time to shut off the current. If the 4,000-horse-power engine at the power station at Oberspree does not help us we shall not reach the speed for which we are all hoping. The engineers at the power-house have not forgotten us. The finger of the speed indicator, as we near Rangsdorf, moves just a little further. And so we cover the last mile which we still have before cutting off the power at top notch speed, with 1,400 kilowatts, or 1,600 horse-power.

A quarter of a mile before reaching the curve near Rangsdorf we shut off the current and apply the full power of the brakes. The speed of the car drops to 102 miles. The curve is rounded in a noble swing. The brake is released, and the car glides along under its own momentum without any current whatever until Zossen is reached. In eight minutes we have leaped from Marienfelde to Zossen. We crowd around the telegraph instruments, which have recorded a speed never before attained in the annals of railroading. The telegrapher can harldy attend to his instruments, so many heads are pressing about him. Finally he succeeds in reading off the record—130.4 miles an hour. Every one smiles, hands are shaken, congratulations exchanged. An officer rushes off to the telegraph station to announce to his Majesty the Kaiser the feat which German engineers have succeeded in performing.

The front end of the car is covered with flies, bees and small insects, crushed as if by a thumb against the iron and glass.

Coal Storage Under Water.

Experiments upon the subsequent storage of coal have been made by Mr. John Macauley, general manager of the Alexandra Docks and Railway, Newport, Monmouth, England. It appears from these that coal thus stored loses an inappreciable amount of its calorific value, compared with that lost by the alternative method of storage with access of air. Mr. Macauley attributes this effect to the more complete retention by the coal of its original chemical properties than takes place when stored in air, due to the depression of natural volatile constituents, to oxidation and weathering effects of sun, wind, rain and frost. He estimates that at present at least a fifth of the coal power is lost unnecessarily, owing to storage in air. The alternative method of storage under water is simple and cheap and readily practicable everywhere.

Brooklyn Rapid Transit Company Makes Changes in Its Transit System.

The Brooklyn Rapid Transit Company has inaugurated several changes in its transfer system. On December 1, the company stopped giving a transfer on a transfer, as under the old conditions those so disposed could arrange a trip and make it possible to ride for miles from either of several termini to a destination and return on a single fare. It is surprising how many combinations of this nature could be worked out.

A number of new transfer stations have been established and this makes it possible to reach all points quickly and for one fare. On short lines continuing trip tickets are issued and a transfer is given on these.

INDUSTRIAL ELECTROCHEMISTRY AND ELECTROMETALLURGY—II.[1]

NOTES ON PROGRESS IN EUROPE AND AMERICA.

BY JOHN B. C. KERSHAW.

The Aluminum Industry in Europe.

The report presented to the shareholders of the British Aluminum Company for the year 1902 is an improvement upon that of the previous year, since a profit of $103,000 is shown on the year's working; but as this surplus does not entirely cover the debenture interest, there is still ample scope for the new management to improve the financial position of the company. The most reassuring statement in the chairman's address at the annual meeting of the shareholders in London in July last was, that the sales of aluminum by the company had greatly increased, and that the heavy stocks of metal held by the company had been in consequence reduced to normal proportions. The average quality of the aluminum produced at Foyers was stated to be 99.4 per cent, and the output was to be increased in order to meet the growing demand. The international arrangement between the various producers of aluminum was also stated to be working more satisfactorily, and the prospects of the British company were therefore greatly improved as compared with the position twelve months ago.

Further capital expenditure upon the plant and workmen's dwellings at Foyers is necessary, and an outlay of $200,000 will shortly be required.

As regards the Neuhausen Aluminum Company, the report for the year 1902 recommends a dividend on the ordinary share capital of fifteen per cent, as compared with thirteen per cent in 1901, and this company is extending its operations by obtaining control of a second water power in Austria. The new power centre is located near Lend-Rawris, and 6,000 horse-power will ultimately be developed at this spot. The total power controlled by the Neuhausen company will then amount to 24,000 horse-power, and the number of its separate works to four. The company will therefore rival the Pittsburg Reduction Company in the extent and magnitude of its resources for aluminum manufacture. Calcium carbide and other products are, however, included in the manufacturing operations of the Neuhausen company, and no very reliable information is available as to the proportion of the total power which is now being devoted to production of the light metal.

Electrolytic Alkali and Bleach in Europe.

The open competition which has been occurring between the various European producers of alkali and bleach since January 1, 1903, and the reduction in price of the latter chemical from $30 to $16 per ton, have had a marked influence upon profits and dividends. The inauguration of a period of free trade in bleach has resulted in the closing down of some of the less well-managed, or well-designed, electrolytic plants on both sides of the Atlantic, until higher prices are obtainable for this product. The American Alkali Company, which had worked the rhodin mercury process at Sault Ste. Marie for some months in 1902, was one of the first to succumb to the fall in value of bleach, and this plant was shut down toward the end of 1902.

In Europe, two of the Swiss electrolytic alkali companies are reported to be in an unsatisfactory position, and the writer believes that manufacture of alkali and bleach in their works has ceased. The difficulties here, however, were partly due to the high cost of fuel for evaporating the soda liquors, and were only indirectly caused by the low price of bleach.

As regards the two English electrolytic alkali companies, both have presented reports which show a marked decrease in profits since the commencement of the present year. It would appear that in one case the present price of bleaching powder still admits of its production by the mercury process without incurring an actual loss. The accounts of the Castner-Kellner Alkali Company only cover three months of 1903, and show a net profit of $208,000 on the year's working. A dividend of six per cent was paid on the ordinary share capital, and $65,000 was carried forward to the next account. This company possesses a reserve of $275,000, and is therefore in an exceptionally strong financial position.

The chairman stated in his address to the shareholders at the annual meeting in May that the directors intended to take up other manufactures than that of soda and bleach, and it was intimated that portions of the reserve fund would be expended upon the necessary alterations to the plant at Weston Point.

The report of the Electrolytic Alkali Company, which works the Hargreaves-Bird process at Middlewich, covers eight months of 1903, and is less satisfactory than the Castner-Kellner report. The net profit for the twelve months is only $2,400, and no dividend can therefore be paid on either the ordinary or preference share capital.

In view of the above facts and figures, relative to some of the more important electrolytic alkali companies, the report of the United Alkali Company, of Liverpool, for the year 1903, will be awaited with interest. If this company, which operates the old Le Blanc process and practically controls this branch of the industry, has failed to earn sufficient profit in 1903 to pay the interest on its preference capital, it is probable that a truce will be called to the present war between the producers of bleaching powder, and that the old arrangement as to production and price will be revived. If, on the other hand, the company which controls all the Le Blanc works in England has not been very heavily handicapped by the period of open competition, and has been able to earn fair profits in 1903, the war of prices is likely to continue until several of the weaker electrolytic companies have been compelled to go into liquidation. The writer believes, however, that the revival of the concordat relating to prices is the more probable development of the situation.

Water Power Centres and Electrochemical Industries.

The recent labor troubles at Sault Ste. Marie, Canada, serves to emphasize the need for caution in sinking huge sums of money in water power developments far in excess of present requirements. At Massena, N. Y., the power company pursued a similar policy, and found itself twelve months ago with a very large installation of electrical plant and machinery, but no large consumers of electrical current. The inevitable result was that the bondholders foreclosed on the property, and the finances of this undertaking are now being reorganized. Mr. Clergue had benefited by the experience at Massena, and had recognized the need for creating at Sault Ste. Marie the industries which should utilize the electrical power when developed. A large number of subsidiary companies were therefore floated to develop these new industries at the "Soo." The cessation of work at the plant of the American Alkali Company, referred to in note 1, and the failure to carry out the original plans for the erection of a large nickel-smelting works at Sault Ste. Marie, also no doubt contributed to Mr. Clergue's difficulties, and hastened the financial collapse.

In time, no doubt, Sault Ste. Marie and Massena will each become a centre of electrochemical and electrometallurgical industry, only second in importance to that at Niagara. But I am much afraid the original shareholders in these two power companies will not have found their investment of a very profitable character.

[1] The first series of these notes by the author appeared in the ELECTRICAL REVIEW, January to April, 1903. For index to the same see issue of April 18, 1903.

ELECTRICAL MINING NOTES.

BY SYDNEY F. WALKER.

The British National Association of Colliery Managers is unique, in that there is one qualification which entitles a man to become a member, and no other will admit him—the possession of a first-class certificate as a colliery manager. Since the passing of the first Mines Regulation Act, every colliery is under the control of a manager, who holds a first-class certificate. This certificate is obtained by passing an examination before a board consisting of mining engineers, after having served not less than five years in practical work in a mine. Second-class certificates are also granted after examination and five years' practical experience in a mine, entitling the holders to the position of under manager. The qualifications of holders of first-class certificates are a knowledge of the Coal Mines Regulation Act, of the principles and practice of surveying and drawing, and a general education in arithmetic. Holders of second-class certificates must possess a smaller quantity of the same knowledge as holders of first-class certificates, and are supposed to be on their way to become holders of first-class certificates.

The National Association of Colliery Managers is a replica, on a small scale, of the Institution of Mining Engineers. It has branches in each coal-mining district, each branch having its own president, committee and secretary, and holding meetings in its own district, under its own officers, usually every month. There is a council of the whole association, consisting of members from each branch, and there is a president of the whole association. There is only one meeting of the whole association during the year, and there are no papers presented for reading at that meeting. The outgoing and incoming presidents of the association usually read addresses, and the remainder of the time, two days and one evening, is devoted to excursions, partly instructive and partly recreative. The papers read before the branch meetings are often of great value, as giving the results of actual experience with different apparatus, and the association awards prizes for the three best papers during each year. The annual meeting is rather one of old friends who meet once a year, than one for instruction. The addresses of the presidents of the association are usually well worth listening to; that of the president at the recent meeting was unusually so.

The only matter in connection with electricity that came up in the president's address was the recent enquiry into the use of electricity in coal mines by the Home Office. The president strongly expressed the view, which is common among old colliery managers, that whatever rules are made in connection with the matter must not hinder the development of the use of electricity in mines. His opinion is that for the economical working of collieries, in the future, it is absolutely necessary that electricity shall be employed, and any regulations which hinder its adoption will increase the cost of placing the coal on the market. Incidentally, in connection with this question, the point has arisen, what is a fiery mine? Every witness at the enquiry was of the opinion that no electric motor should be allowed to run where gas was present, and this has been taken to mean by some that no electrical apparatus shall be used in fiery mines, and the definition of a fiery mine is not at all an easy one. Mining engineers are very much divided as to what constitutes a fiery mine, that is to say, a mine which is dangerous. If it be taken to be a mine in which safety lamps are used, the restriction of the use of electrical apparatus to those in which naked lights are used would cut off more than half of existing mines. On the other hand, witnesses were almost unanimous that an electric motor properly constructed is no more dangerous than a miner's lamp.

THE OPPOSITION TO THE USE OF ELECTRICITY.

The great use of meetings of this kind, as already pointed out, is the chance of comparing notes, which it enables men who have been working independently for the previous year to take advantage of. One of these opportunities occurred at the meeting in question. The excursion on the day after the reading of the president's address was to the collieries of Messrs. Henry Briggs, Sons & Company, the manager of which, Mr. Isaac Hodges, is president of the Yorkshire branch of the association. There is no electrical apparatus about the place, and costs are stated to be lower at these collieries than anywhere else. I had a conversation with Mr. Hodges on the subject, and put the question perfectly straight to him, "Why have you so little electrical apparatus?" "Because," he said, "I do not think that anything is gained by it. The efficiency of electrical distribution is undoubtedly higher than that of compressed air, but it only gives a saving in cost of one cent per ton in cutting the coal, and the danger may easily cost considerably more than that." Mr. Hodges uses compressed air for pumping underground and coal cutting, but he uses gas engines wherever they are practicable, as at the shaft bottoms. The haulage is largely worked by steam engines on the surface, which drive haulage drums at the pit bottom that can be clutched in or out at will by the attendant at the pit bottom, the power being transmitted to the bottom by means of band ropes. Most elaborate arrangements have been worked out for stopping and starting the haulage engine on the surface from the pit bottom. The secret of the whole thing is, the gas engines are worked and the boilers fired by a very rich gas which is made at the works as an offshoot of the colliery firm.

I venture to think that the time will come when those band ropes in the shafts will be done away with and electric motors fixed at the pit bottoms to drive the haulage drums. The arrangement which enables the attendant to stop and start the engine on the surface, from the underground haulage chamber, is very beautiful, and works well, but it is neither as simple, as quick, nor as convenient as an electric motor would be. Mr. Hodges told me that the cost per horse-power for all his work was only £2 per annum. Still it appears to me that there is no reason why he should not have the advantages of the cheap gas, and of electric distribution too. Cables are troublesome in a pit shaft, but so are gas pipes, and the care which will enable gas pipes to work economically, will keep the repair of cables at a very small figure.

In the very early days of electric lighting, I put in a plant at a colliery in the county of Durham, to light the pit top. Previously to this, it was lighted by gas from the company's own works about one and one-half miles away. The manager at the colliery told me that the cost of repairs would pay interest and upkeep of the new plant and leave a good margin. Joints were constantly leaking, etc. At the same time, it is as well for those who are endeavoring to push colliery work to know what they have to overcome. At another colliery in the Midlands, a few days ago, I saw a very complete system of rope haulage. One installation in particular struck me. The coal-picking belt was in a shed several hundred yards from the colliery, and it was worked by a rope which ran across country on pulleys to the shed, and then turned sharply at right angles, ran along the side of the shed, and round the driving pulleys of the belt, passing on its way several other ropes do-

ing somewhat similar work. I ventured to prophesy here, that those ropes would disappear, whenever an electrical power plant came on the ground. I was told that when the plant was put in, the figures were carefully taken out for rope and electricity, and rope was much cheaper. Meanwhile it does its work well, and there are numerous men about the colliery districts who reap a handsome living by splicing the ropes from time to time. The mechanical engineers of the collieries in the Midlands also have acquired a good experience with rope haulage.

Mr. Hodges is also working at the compressed air problem, and has already done a good deal. He told me that he had succeeded in working the air which is used to drive a coal-cutting machine expansively. This is an immense step in advance. If air can be worked at high pressures, similar to those used in the United States, leakage suppressed, and the air used expansively, it will supplant electricity for all work at the face of the coal, and wherever gas is feared.

The little apparatus for lighting locked safety lamps, I expect all readers are familiar with. There are two arrangements in this country for the purpose, one that has been invented and reinvented several times, in which a heated platinum wire lights the lamp, and the other, which is new, so far as I am aware, within the last few years, in which ignition is obtained by means of a spark from an induction coil. The miner's oil lamp consists of a hollow cylinder forming the oil well, with the wick in the centre. The oil well is screwed on to a brass ring which forms the base of the glass and chimney of the lamp. The glass, which is made only high enough to allow the rays of light to come out in a horizontal direction, is held between two brass rings, which also hold stout brass wires that protect the glass from mechanical injury. The upper brass ring forms the base in which the gauzes which form the chimney of the lamp rest. There are three gauzes, one inside the other, the outer one protected by a steel bonnet from mechanical injury. The upper part of the bonnet is perforated with holes about one-quarter inch in diameter, all round, and these are the only points of egress for the products of combustion. Air is supplied to the lamp by a similar series of holes in the lower brass ring, inside the glass, the holes being covered with gauze. It will be understood that the apparatus so arranged, while not absolutely safe—no miner's lamp is, where an explosive mixture is present and is being transported along the workings at a high velocity—does not give very much light, from one-third to two-thirds of one candle-power when the lamp is first lighted, and it is very easily extinguished. The miner is not allowed to open his lamp to relight it, if it does go out. Various penalties await him if he does, and is caught, and various plans have been adopted to prevent him making the attempt. If it does go out at the working face, or anywhere in the mine, the collier has to take it to the lamp station, which is situated as far in the workings as it is considered safe to use naked lights, and there a man who is told off for the purpose opens it, relights it, and again locks it. Any method which enables the lamp to be relighted without opening enables the lamp station to be fixed very much farther toward the working face, and saves considerable time, as well as removing temptation from the miner. While the lamp is being taken to the lamp station, the collier and his "butty" have to stop working, as the "butty's" lamp is required to light the man on his way to the lamp station. In some collieries this trouble is met by sending lads round periodically with lighted lamps to all the working faces, but in the majority of cases the men have to lose the time taken.

With both systems of electrically relighting, the oil well is made to form one side of the circuit, and an insulated contact rod passed through the well forms the other side. With the hot wire, a second small rod is fixed near the first and a fine platinum wire stretched between the two, which can be turned over the wick, or away from it. With the spark system, the spark is made to pass through the vapor of the oil to the body of the lamp. In either case, a circular table is arranged, just large enough to admit the base of the lamp, with contacts corresponding to the oil well, and when the lamp is placed on the table, either a spark passes or the wire becomes hot, and the lamp lights. In one colliery in South Wales, where some 2,000 lamps are in use, considerable time is saved by this arrangement. The lamps are not lighted, as they usually are, by the lamp trimmer, but are given out ready trimmed. Each man, as he receives his lamp, passes on past one of the tables described, dumps his lamp down, takes it up lighted, and goes on to the pit top. Similar tables are fixed at the lamp stations. Under the tables are carried the induction coil, where the spark method holds, and two secondary cells, or only secondary cells where the batteries are used in the lamp room, there is an arrangement for unlocking the lamps by means of an electromagnet, which is also concealed under the table. The lamp is locked by a steel pin which fits into a slot provided for it, and is held there by a spiral spring. As long as the pin is in the slot the oil well can not be revolved, and so can not be unscrewed from the ring above, so that the lamp can not be opened. When the pin is pulled down by the electromagnet, the well can be turned, and the lamp filled. At Messrs. Briggs collieries, where the battery method is employed, the lighting in the lamp room is done by means of current furnished by a small dynamo driven by a belt from the shafting which runs the lamp cleaning machinery.

The Electric Railway at La Mure, France.

The coal basin of La Mure, France, is rich in anthracite, but on account of the grades the steam railroad was not able to handle the traffic and develop the mines. To correct this defect, an electric system has been installed which will greatly increase the capacity of the road. The road is about eight kilometres long and seventeen trains are run in each direction. The electric locomotive is here described by M. A. Soulier. The Thury system of continuous currents was selected. The locomotive weighs fifty tons, is 13.18 metres long with a cab in the centre and is carried on two four-wheeled trucks. Power is collected from two overhead wires by four bow collectors. The two wires and the track form a three-wire system with 2,400 volts across the outers, the track being the neutral. Four motors, one driving each axle through gears, are connected permanently in series, each supporting 600 volts. They are rated at ninety kilowatts, run at 400 revolutions per minute when taking 185 amperes and have six poles. The controller contains two cylinders, one having twelve and the other eight contact positions, thus making ninety-six possible positions for controlling the motors. The cylinders are turned by means of a handle with a multiplying motor. The rheostat is formed of coils of wire and is used in starting and for braking the cars, the motors being connected to it for this purpose. There are in addition, a hand brake and an air brake, operating brake shoes on all the cars.

THE INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION.

THE REGULAR ANNUAL CONVENTION OF THE INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION WILL BE HELD AT THE AUDITORIUM HOTEL, CHICAGO, ILL., DECEMBER 8, 9 AND 10.

The Interstate Independent Telephone Association was organized in Chicago, Ill., April 9, 1902. The initial gathering was held at the Sherman House, and delegates to the number of about 500, including practical telephone men, exchange promoters and manufacturers, gathered from the states of Indiana, Illinois, Kentucky, Iowa, Wisconsin and Michigan. Dr. I. A. Lumpkin, of Mattoon, Ill., was elected temporary chairman. He delivered an address in which he sketched briefly the advantages that an association of this character would bring, by holding in closer touch the representatives of exchanges in the closely allied states included in the organization.

On the evening of the inauguration day, a banquet was tendered to the delegates and visitors by the telephone manufacturers of Chicago. Informal toasts were responded to by the telephone men, and from this auspicious occasion there sprang into being one of the most successful and influential telephone organizations of the country.

A permanent officiate was elected on Thursday, April 10. The president chosen was Mr. Henry Clay Raney, of Fairfield, Iowa. Mr. Raney died on August 21, 1903, at Fairfield, Iowa, and in his death independent telephony lost a vigorous exponent. His knowledge as a lawyer of corporation affairs made him a master of many intricacies which the formation of such an organization involved. He was the organizer of the Jefferson County Telephone Company, of which he was president.

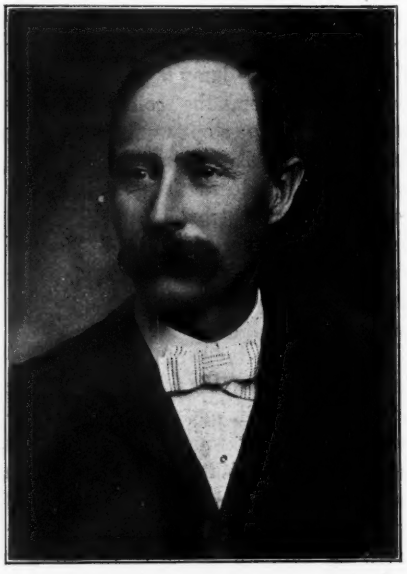
The vice-president chosen was Dr. I. A. Lumpkin, of Mattoon, Ill.; the treasurer, Mr. J. C. Harper, Madison, Wis.; the secretary, Mr. E. M. Coleman, of Louisville, Ky. Mr. Coleman is secretary of the Home Telephone Company, of Louisville, Ky., a man of large affairs in the telephone field, and one well suited to carry out this executive department of the association's affairs. Mr. Coleman has since succeeded himself twice, and is probably the logical candidate for succession once more.

The executive committee was chosen as follows: H. K. Cole, Owensboro, Ky.; J. B. Ware, Detroit, Mich.; Charles E. Hull, Salem, Ill.; George N. Bandy, Perry, Iowa; J. W. Layne, Carthage, Mo.; A. L. Hutchinson, Weyauwega, Wis., and L. A. Frazee, Connersville, Ind.

A number of interesting and instructive papers was read by Dr. C. F. Bennett, of Waterloo, Iowa; Richard Valentine, of Janesville, Wis.; H. C. Raney, of Fairfield, Iowa; L. A. Frazee, of Connersville, Ind.; E. M. Coleman, of Louisville, Ky.; E. R. Conklin, of Aurora, Ill.; W. H. Crum, of Chicago; A. L. Hutchinson, Weyauwega, Wis., and Dr. H. S. Herr, of Ottumwa, Iowa.

Early in September of 1902 a meeting was held by the officers of the association, and the date of the next meeting was decided on as December 9, 10 and 11, 1902. Dr. I. A. Lumpkin and Charles E. Hull were members of this committee.

The second general meeting was opened with a good attendance and sentiments of greatest harmony at the Auditorium Hotel, Chicago, on December 9, 1902. President Raney called the convention to order, and Mr. J. W. Keelyn, chairman of the Chicago entertainment committee, introduced the Hon. Lawrence E. McGann, comptroller of the city of Chicago, who, as the representative of the mayor, delivered an address of welcome to the delegates. President Raney made an eloquent and masterful response to this address, and Senator Charles E. Hull, of Salem, Ill., made the report for the executive committee.



THE LATE HENRY C. RANEY.
First President of the Interstate Independent Telephone Association.

The secretary's annual report showed the condition of affairs to be promising, and put forward a number of valuable suggestions for the unified carrying on of the association's work.

The representatives then selected one member for each state, to serve on a committee on nominations. The following members were subsequently chosen: W. Guy Jones, Columbus, Ohio; Dr. H. S. Herr, Ottumwa, Iowa; W. F. Goodrich, La Crosse, Wis.; William Robinson, Muskegon, Mich.; L. A. Frazee, Connersville, Ind.; Senator C. E. Hull, Salem, Ill.; W. F. Hall, Clinton, Mo., and H. K. Cole, Owensboro, Ky.

At this session important committees were established to consider the question of whether men who were affiliated with Bell companies were eligible for attendance at the association's meetings; and also on the important question of an indiscriminate making of toll contracts with other than strictly independent companies.

At the meeting on the next day, December 10, the committee on eligibility for membership made two separate reports to the convention. One was to the effect that the association pledge its members not to patronize supply houses selling material to new companies that were formed to compete with independent companies already in the field and giving satisfactory service.

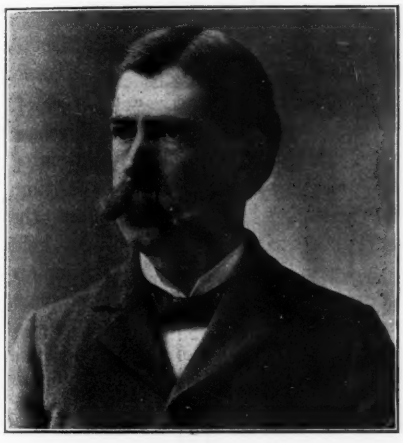
On the other question, the decision was made that, as toll connections with Bell companies would have a tendency to discourage the building of independent toll lines, no one should be eligible for membership in the association who had any contract for toll or instrument connections with a Bell company, unless in certain special cases where permission might be granted by two-thirds of the membership committee of the state, interstate or national association. These two resolutions were carried.

Several papers were read at this session, one by Mr. George N. Bandy, of Perry, Iowa, on "Rates-Measured Service." This was followed by the reading of a paper by Dr. H. S. Herr, of Ottumwa, Iowa, on "Sliding Scale Rates for Exchanges." Miss Flora B. Herr, Dr. Herr's daughter, read this paper in his absence. H. H. Robinson, Cleveland, Ohio, read a paper on "Toll Rates."

The programme at this point was interrupted to allow Professor W. E. Goldsborough, chief of the Department of Electricity, Louisiana Purchase Exposition, to address the convention. Dr. Goldsborough set forth the many advantages which St. Louis would offer as a convention city during the early summer of 1904. A resolution was offered by J. W. Layne, to the effect that the association meeting of 1904 should be held in St. Louis. As the exposition will close about December 1 of

that year, the constitution of the association would have to be amended in order that a meeting could be held before that time. This matter was finally referred to a committee, which was required to report upon the resolution and also introduce a motion removing the constitutional restriction for this particular occasion.

An interesting feature of this meeting was a series of papers from members representing the nine states covered by the association, on "Restrictions by Municipal Authority and Synopsis of the Law." Notwithstanding the expectation that there would be responses from nine states, but three representatives undertook the debate on this subject. These were W. F. Laubach, of Akron, Ohio; E. W. Pickhardt, Huntingburgh, Ind., and M. Savage, Champaign, Ill. Mr. J. B. Ware addressed the meeting on this subject, however, and gave considerable information as to the municipal restrictions in the state of Michigan.

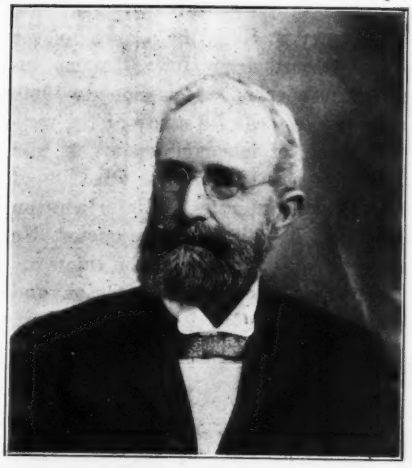


Senator Charles E. Hull.
President, Interstate Independent Telephone Association.

After this meeting had adjourned, the delegates were made the guests of the Chicago Automatic Telephone Company, and investigated the subways which this company was building under the streets of Chicago.

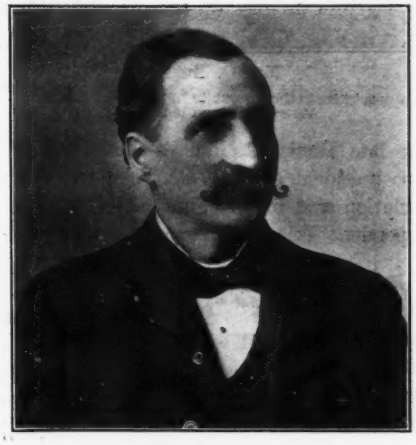
The first business of the session on Thursday, December 11, was the introduction of a resolution by the committee appointed to act on the invitation issued by Professor Goldsborough, on behalf of the St. Louis Exposition. This resolution favored the association's holding its annual convention in 1904 at St. Louis, at such time as the executive committee might determine, and recommended that the constitution be amended as to the time of holding meetings, so that the convention of 1904 might be held during the month of November. This resolution was unanimously adopted.

W. F. Hall, of Clinton, Mo., and A. L. Hutchinson, of Weyauwega, Wis., addressed the meeting, and these were followed by H. E. Ralston, of Maitland, Mo.; Colonel J. D. Powers, of Louisville, Ky., and J. W. Layne, of Carthage, Mo., who spoke on practical telephone subjects.



Mr. John W. Layne.
Treasurer, Interstate Independent Telephone Association.

Mr. J. J. Nate, Chicago, Ill., read a conclusive paper on "The Telephone Transmitter, Its Early History, Its Present Status with Relation to the Berliner Patent." The last paper on the programme was by Senator Charles E Hull, of Salem, Ill., on "Suggested Methods for Improving Long-Distance Telephony."



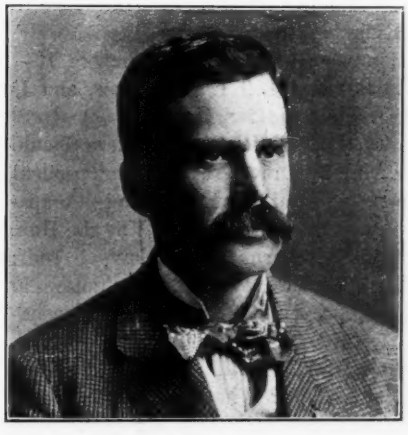
Dr. Henry S. Herr.
Representative to Interstate Independent Telephone Association from Iowa.

Following this, the committee on nominations reported, and officers for the ensuing year were elected as follows: president, Charles E. Hull, Salem, Ill.; vice-president, L. A. Frazee, Connersville, Ind.; secretary, E. M. Coleman, Louisville, Ky.; treasurer, J. W. Layne, Carthage, Mo. Executive committee: Ohio, W. Guy Jones, Columbus; Iowa, H. S. Herr, Ottumwa; Wisconsin, A. L. Hutchinson, Weyauwega; Minnesota, E. H. Moulton, Minneapolis; Michigan, J. B. Ware, Detroit; Indiana, O. Rex, Manchester; Illinois, A. B. Conklin, Joliet; Missouri, W. F. Hall, Clinton; Kentucky, David Prewitt, Winchester.

The association received an invitation from R. H. Watrous, of Milwaukee, Wis., to hold its next convention in Milwaukee. The matter of the date and place of meeting, however, were left to the discretion of the executive committee.

In the evening an elaborate banquet was tendered to the delegates, toasts being given by a number of prominent telephone men and by several executives of the city.

The third general meeting of the association will be held at the Auditorium Hotel, Chicago, Ill., December 8, 9 and 10, 1903. An elaborate programme has been arranged, including papers by prominent men on important subjects. In addition to this, a banquet will be given, which the committee in charge promises will surpass all previous ones. A large orchestra has been engaged to render several musical programmes, and there is no doubt that this convention will be as successful, at least, as those which have already been held.



Mr. A. L. Hutchinson.
Representative to Interstate Independent Telephone Association from Wisconsin.

The following programme has been announced:

Tuesday Morning, December 8—Reception of members and friends by the executive committee and officers, at the secretary's headquarters.

Tuesday Afternoon—Address of welcome, by the Hon. Carter H. Harrison, Mayor of Chicago; response and annual

address by the president, Senator C. E. Hull, Salem, Ill.; report of the secretary and report of the treasurer will be read; selection of executive board; selection of nominating committee, and revision of constitution and by-laws.

Wednesday Morning, December 9—The officers and executive board will take charge of the delegates. Visiting exhibits.

Wednesday Afternoon—Wednesday afternoon will be devoted to addresses as follows: "Should the Territory of the Interstate Independent Telephone Association Be Enlarged, and if so, Why?" by the Hon. John Van Nortwick, Appleton, Wis.; "Are Our Telephone Periodicals Sufficiently Careful as to the Business Relations Sustained by Contributors?" by W. H. McDonough, New York, N. Y.; "Standardization of Apparatus," by Professor J. C. Kelsey, Purdue University; "Standardization of Construction," by W. C. Polk, Kansas City, Mo.; "Competition Between Independent Companies and Farmers' Mutuals," by O. Rex, North Manchester, Ind.

Thursday Morning, December 10—"Independent Toll Line Systems, and Is the Time Ripe for Merging," by J. S. Bailey, Jr., Toledo, Ohio; "Where Should the Line Be Drawn Between Independent Operating and Manufacturing Companies, and the Bell Company," by the Hon. Henry A. Barnhart, Rochester, Ind.; "What Should Be the Representation in Connection of the Interstate Independent Telephone Association in Voting?" by David Perwitt, Winchester, Ky.; "Who Is Who? What Are the True Ear Marks?" by the Hon. Theodore Gary, Macon, Mo.

Thursday Afternoon—Officers and executive board will take charge of and entertain the attending delegates. Visiting exhibits.

Mr. John W. Layne, treasurer of the Association, has been an active business man in the States of Indiana, Ohio, Illinois and Missouri for the past fifty years. About five years ago he entered the independent telephone field, purchasing the Carthage Telephone Company, of Carthage, Mo. He rebuilt this system, and under his management the plant grew until it absorbed five other independent systems. This expansion continued until Mr. Layne was president, manager and chief owner of the third largest independent system in Missouri, operating as the Mineral Belt Telephone Company, with its central office at Joplin. After four years of vigorous upbuilding Mr. Layne sold this system to a new syndicate, and Mr. Theodore Gary, of Macon, Mo., became active manager and president, the name being changed to the Home Telephone Company. Mr. Layne was made, and now is, vice-president of the new company, and although having passed his sixty-seventh year is still a vigorous worker in the telephone field.

Dr. Henry S. Herr, the member of the executive board from Iowa, became interested in independent telephony in 1900. He has made a careful study of the various elements of telephone operation, and has always been an earnest advocate of a sliding scale of rates. His articles on this subject have been widely quoted. He was one of the organizers of the Interstate Independent Telephone Association and placed in nomination for first president,

MR. O. REX.
Representative to the Interstate Independent Telephone Association from Indiana.

the late Henry C. Raney. Dr. Herr is also president of the Iowa Telephone Association and of the Southern Iowa Independent Telephone Association.

Mr. A. L. Hutchinson, the member of the executive board from Wisconsin, was born at Weyauwega, Wis., January 25, 1859. He lived on a farm near the village from the age of three to twenty, and taught in the district schools in Wisconsin and Iowa for two years. He read law in the office of Pike & Vankusen, Oshkosh, and was admitted to the bar in March, 1881. In October, 1882, he was appointed postmaster of Weyauwega, and served in this capacity for three years. He was elected district attorney of Waupaca County in 1886 and reelected in 1888. Mr. Hutchinson edited a local paper from 1886 to 1893 and was delegate to the National Editorial convention which visited the City of Mexico in 1888. He was an alternate delegate to the National Republican convention at Minneapolis in 1896. In 1894 Mr. Hutchinson became interested in a small independent telephone company and after three years gave up his law practice to devote his entire time to independent telephony. He organized and was first president of the Independent State Telephone Association of Wisconsin. He is at present secretary and general manager of the Interurban Telephone Company and president and general manager of the Independent Consolidated Telephone Company.

Mr. O. Rex, the member of the executive board from Indiana, is president of the North Manchester Telephone Company. Mr. Rex is a pioneer telephone man, and gave Wabash County its first independent toll line service and the only telephone connection which it had with adjoining counties for more than three years. He started in the telephone field in 1894, and has been active ever since in promoting independent telephone operations.

The Universal Exposition Handbook.

Dr. Charles M. Kurtz, assistant chief, Department of Art, Louisiana Purchase Exposition, has prepared an illustrated handbook on the universal exposition, commemorating the acquisition of the Louisiana territory, which will be held at St. Louis, Mo., 1904. The frontispiece of this handsome book is a photogravure reproduction of the Hon. David R. Francis, president of the Louisiana Purchase Exposition. The book sets forth in detail the preparation for and the scope of the St. Louis world's fair of 1904, giving interesting bits of history showing the development of the territory since its acquisition by the United States Government. Half-tone portraits of all of the prominent officers of the exposition are given, together with illustrations of the numerous buildings in various stages of completion.

National Electric Light Association.

Mr. Ernest H. Davis, the secretary of the National Electric Light Association, announces that there have been so many requests from non-members for the report of the Chicago meeting, now in press, that it has been decided to present a copy of this book to all companies making application for membership for the year 1904, provided their applications are received before the end of the present year. A number of applications has already been received on this basis, and there is every indication of a large increase in membership during the month remaining. A copy of the recent reports of rates for lighting and power will also be sent to new members.

THE COMPARATIVE BEHAVIOR OF FLOATING AND BOOSTER-CONTROLLED BATTERIES ON FLUCTUATING LOADS.

(Concluded.)

BY LAMAR LYNDON.

CASE III—BATTERY WITH BOOSTER IN POWER STATION.

Since with a booster-controlled battery the generator load is kept practically constant, it matters little what kind of generator is used in the power station, it being only necessary to settle on the best average station voltage. Assuming 550 volts as the desired electromotive force at the station, a 550-volt battery, the same load and general conditions as in case 1, the size of battery is to be determined. Since the average load is 600 amperes, and the maximum 1,000, a battery to discharge 400 amperes is required. If the one-hour rate is not to be exceeded, an 800-ampere-hour battery is necessary. The maximum load, however, comes on the system, but infrequently, as shown by the load diagram and as it lasts only five seconds, a 700-ampere-hour battery, having a one-hour rate of 350 amperes, will be ample as it will only have to give out seventeen per cent in excess of its rating, and then for a negligible time. Even a 600-ampere-hour battery would work satisfactorily on this load.

Assuming a 700-ampere-hour battery in the station, practically all the fluctuations in load will be absorbed and the generator load curve becomes a straight, or rather a wavy line. The station voltage being constant, the feed point electromotive forces at various line loads are not quite so satisfactory as are furnished by a compound-wound generator. If the minimum voltage at the feed point is to be 350, the resistance must not exceed 0.2 ohm or 0.1418 ohm for the copper resistance, requiring 805,000 circular mils as against 665,000. The generating equipment, however, is reduced in size from 550 kilowatts to 350 kilowatts and the fuel economy greatly increased.

COMPARISON OF CASES I AND III.

As compared with the shunt-wound generator working with a floating battery in the power station, the generating equipment is 330 kilowatts as against 440; the copper, 805,000 circular mils as against 945,000; the load variation six per cent as against forty-seven per cent; the voltage variation at the feed point nineteen per cent as against twenty per cent—these two factors being practically equal, because of the greater amount of copper in the line fed from the floating battery.

CASE IV—BATTERY AND BOOSTER OUT ON LINE.

If the floating battery out on the line has a booster auxiliary working with it, the current passing over the feeder will be maintained constant, and the average load only will be transmitted from the power station. If, as in the previous cases, the voltage is not to fall below 350 volts, the resistance (assuming 550 as the generator voltage) will be 0.333 ohm total or 0.2751 ohm for the copper; equivalent to 415,000 circular mils. This, however, is not so advantageous as it seems, for the voltage at the point where the booster is located is constant and the electromotive force will neither fall below 350 nor will it rise above it. Taking 420 volts as a satisfactory pressure, the resistance of the line becomes 0.217 ohm = 0.1588 ohm for the copper = 720,000 circular mils. This allows the maintenance of a satisfactory potential which varies so slightly as to be practically constant.

COMPARISON OF CASES II AND IV.

Compared with the floating battery on the line, the booster-controlled system gives a higher and more satisfactory voltage; the copper is 720,000 circular mils as against 495,000 circular mils. This is not a real comparison, however, in view of the higher voltage maintained. The load on the generating equipment is kept constant within six per cent as against a variation of seventeen per cent; the power-house capacity required is 330 kilowatts against 385 kilowatts.

While the booster-controlled battery out on the line is theoretically superior to a similar equipment in the power station, it requires extra attendance, which in many cases offsets its advantages and makes it advisable to put the booster and battery in the station and add a little more copper to the line, or install a floating battery at the feed point.

Furthermore, the usual condition in practice is that of a power plant supplying current to numerous feeders, no single one of which carries sufficient current, or is enough longer than the others, to warrant a battery installation only to take care of its load and voltage. Generally, therefore, in order to regulate the station load, the battery and booster must be in the power station.

The advantages shown by the booster-controlled batteries over those floating across the circuit do not include a most important one; namely, the ability to obtain full battery discharge even when the stored energy in the cells is nearly exhausted and the voltage decreased below normal. The battery characteristic (Fig. 1) shows that the minimum voltage, when discharging at the hour rate, is 1.915 volts per cell. This is the case only when the battery is worked nearly fully charged, and the output and input are so nearly equal that the state of battery charge is practically unchanged. If, however, any unusual condition or event should raise the average load on the system, the output might exceed the input for several hours, and the battery so far exhausted that the voltage would fall to 1.7 per cell when discharging at the one-hour rate. This is a decrease of 0.215 volt per cell—or fifty-eight volts in a 550-volt battery—below the minimum voltage of discharge when the battery is working at a point near full charge. Obviously, without a booster the battery in this condition would not be of any assistance at all in the power station, and its regulating ability out on the line greatly impaired.

Another advantage offered by the booster is that the necessary overcharge is not attended by a troublesome manipulation of water barrels, with the usual accompaniment of heavy grate-bars and a jug of sulphuric acid.

CASE V—BOOSTER IN STATION; BATTERY ON LINE.

The final method of installing the battery, that is, with the booster in the power-house and the battery out on the line, is peculiar in that only one type of booster may be used, and there must be a separate feeder from the booster to the point where the battery is located. In the foregoing discussions a single feeder from the power station to the feed point has been assumed to simplify the comparison, which is just as valid in its results as if the load had been distributed over the length of various feeders. If the circuits in the cases discussed were merely a simple trolley and track with distributed loads, any of the four described applications could be used, except that the booster system shown in Fig. 15 would not be suitable as the auxiliary for the battery floating on the line.

Character of Booster—A particular arrangement of the type of booster shown in Fig. 15, causes it to allow only a practically unvarying current to pass through its armature. Referring to Fig. 16, G is the generator; B the booster armature; *f* a shunt field; S a series field; E the battery, and MM the motors or variable load. The voltage across the mains at X is obviously the generator voltage, while the potential at the terminals of MM is

equal to the voltage at X plus that of the booster. As in the case of the booster shown in Fig. 15, the shunt and series fields are in opposition; but at normal load, the magnetization of the shunt field exceeds that of the series field, and an electromotive force is generated in the booster armature, which is added to that of the generator to produce normal voltage across the mains. The battery being connected directly across the mains, its normal voltage is equal to that of the generator, plus booster.

If an excess load should come on the system, the generator tends to send additional current to the line, strengthening S and reducing the booster voltage and consequently the potential across the mains. The battery then discharges. The converse occurs on increase of load; the booster voltage rises, and current flows into the battery. This system allows only a constant current to pass through the booster armature and is therefore known as the constant-current booster.

In Fig. 17 is shown the method of applying this machine to the case in hand. The symbols are the same as in Fig. 16; T is the trolley; R the track and F feeder from the booster. The shunt coil *f* is connected across the line and coil S in series with the feeder F.

Line Drop—In Fig. 18 the curve A represents the voltage which obtains along a line fed from one end and with the load uniformly distributed along its length.

In the figure, the drop at the distance L, from the source of is seen to be 350 volts. If from P only one-half the circuit is supplied with current, there will be a decrease in the drop due to lowered resistance, and a further decrease due to the fact that only one-half the current flows over the feeder. If the distributed load from P to E is 1,000 amperes and the drop 350 volts, the load over one-half the distance is 500 amperes and the resistance of the circuit one-half that from P to E, so that the drop is one-fourth of 350 or 87.5 volts, if the circuit extend only to N. This shows that the drop at the end of a main supplying current to a given distributed load varies directly as the square of the distance over which it feeds.

Data of System—Assume the same conditions as in previous cases and shown in Fig. 19, taking the load as being equally distributed along the line, which, in this case, however, is five miles in length instead of two miles, as before. Computations for drop on a two-mile line with this system show the cross-section of the copper to be so small that it has not the requisite current-carrying capacity. The copper which extends along the entire length of the circuit will be taken as 400,000 circular mils inclusive of the trolley wire. The resistance per mile of circuit is 0.1424 ohm for the copper and 0.0291 for the track, making 0.1715 ohm per mile, or 0.8575 ohm total. The drop on distributed load is 429 volts at the far end of the line when 1,000 amperes pass over it. This is shown by curve No. 1 in Fig. 20. It is desired so to place the battery on the line as to reduce the drop to 150 volts, putting the booster in the power station, and adding such an amount of copper as may be necessary.

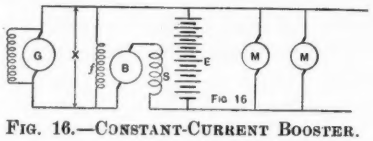


Fig. 16.—Constant-Current Booster.

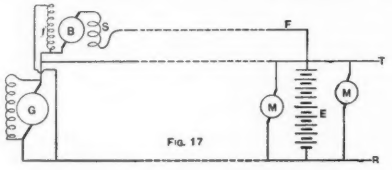


Fig. 17.—Booster Connections.

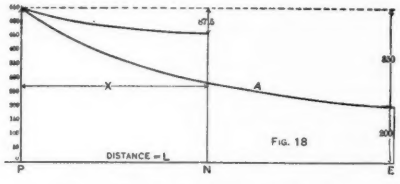


Fig. 18.—Line Drop Curves.

Location and Voltage of the Battery—Since the drop from the power station varies as the square of the distance over which a distributed load is supplied, the distance X to which the original copper can feed at a drop of 150 volts, is computed by the proportion:

$X^2 : (5)^2 :: 150 : 439$, from which

$X = 2.89$ miles, which is shown at point B.

The remaining distance, or 2.11 miles, is to be divided into two equal parts and the battery so located that it will feed in each direction 1.055 miles, which is its distance from the end of the line. Point C shows its position. Its voltage Y is fixed by the condition that the line voltage must not fall below 400 volts. Applying the above proportion:

$$(5)^2 : 429 :: (1.055)^2 : Y$$

$$Y = \frac{429 \times (1.055)^2}{(5)^2} = 19.1 \text{ volts}$$

= drop for the distributed load on either side of the battery, which is located at C. 19.1 + 400 = 419.1 = battery voltage when discharging at maximum rate or 1.915 volts per cell.

$$\frac{419.1}{1.915} = 219 = \text{number of cells in series.}$$

219 × 2.025 = 443.7 = voltage at C, with normal load on system, battery neither charging nor discharging, 2.025 being the open-circuit voltage per cell as shown in the characteristic (Fig. 1). Voltage per cell is 2.14 when charging at maximum rate.

2.14 × 219 = 468 = volts at battery at maximum charge.

Feeder to Battery—The total current to that portion of the system past B away from A, must be supplied by the feeder F (Fig. 18), and this current Z is determined by the proportion.

$(5 - 2.89) : Z :: 5 : 600$, whence

$Z = 253.2$ amperes.

The size of the feeder F is now to be decided on. If its current-carrying capacity be sufficient to allow 253 amperes to flow, its resistance is of little moment so far as the operation of the system is con-

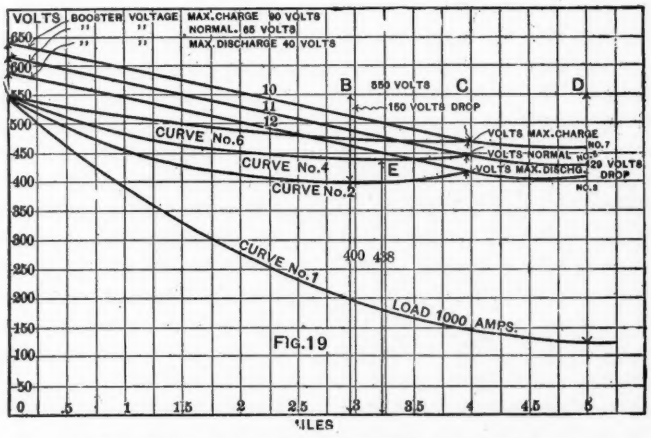


Fig. 19.—Data for Line Five Miles in Length.

cerned, since the voltage of the booster can be made sufficiently high to compensate for any feeder drop. This resistance, however, is commercially a serious factor, since the booster energy input is lost. The question then, is to determine the most economical cross-section of copper, which is beyond the scope of this paper. For purposes of the discussion assume it to be 400,000 circular mils; resistance, 0.1424 ohm per mile. Resistance of circuit = 0.1424 + 0.0291 = 0.1715 ohm per mile; or 0.1715 × 3.95 = 0.6774 ohm, total. The drop then to C = 0.6774 × 253 = 171.4 volts. 443 + 171.4 = 614.4 = voltage of generator plus booster at the station. 614.4 — 550 = 64.4 = booster voltage when average load is on the line. Since the current is constant, the drop to C is also constant, hence for variation of battery voltage to cause charge or discharge, the booster voltage must vary as indicated at A. The straight lines 10, 11, 12 show the drop along the feeder.

Changes with Load Variations—As the load decreases and the line voltage rises, the distance that the line will feed toward the battery is increased as shown by curves 4 and 6, while curves 5 and 7 show the corresponding rise of potential at the end of the line. At normal load of 600 amperes total, the minimum voltage is 438 and the point of lowest potential has moved outward to E, the station now feeding from A to E. When the minimum load of 260 amperes is supplied the drop from A to C is only seventy-three volts, making the line voltage at C 477, which is five volts higher than that of the battery on charge. Therefore, the line will supply all current from A to C, and also send enough into the battery to bring the voltage at the line down to 468; which extra current to the battery is nine amperes.

BATTERY CAPACITY.

Since the battery regulates 2.11 miles of the system, the average current as shown is 253 amperes, while the maximum is

$$\frac{1000 \times 2.11}{5} = 422 \text{ amperes.}$$

Therefore, the one-hour discharge rate should be 422 — 253 = 169 amperes, making the battery capacity 340 ampere-hours. The constant current from the booster, however, must be taken care of. On light load the line is furnishing all current up to C, and also nine amperes to the battery, making 262 amperes flowing to this point. The current consumption from C to D is only $\frac{260 \times 1.055}{5} =$ 54.8 amperes; 262 — 54.8 = 207.2 amperes, going to the battery which should not be in excess of the one-hour rate of charge. This necessitates the use of a 414-ampere-hour battery.

Results—This system then distributes current over five miles with a maximum current of 1,000 amperes: the minimum voltage is 400, the average 438; the fluctuations on the system are from 260 to 1,000 amperes, on the generator from 458 to 831. This is accomplished by the use of nine miles of 400,000 circular mils feeder, a twenty-four-kilowatt booster, a 450-kilowatt generator, and 261 cells of 400-ampere-hour capacity.

This paper has covered, it is true, only one set of conditions, but from it can be learned the method of investigation applying to any particular set of conditions; and it also shows that the setting forth of any general formulas or deductions to be applied indiscriminately is practically impossible.

The Telephone.

[*Editorial from the New York Times.*]

In an address delivered before the Underwriters' Club in this city on November 24, Mr. C. J. H. Woodbury, of Boston, an officer of the American Bell Telephone Company, gave some figures of exceeding interest respecting the telephone development in this country which will assist one who considers them thoughtfully to appreciate the extent to which the simple and familiar act of sending or receiving a communication by this method sets in motion titanic forces and to understand the magnitude and mechanical perfection of the plant provided for his convenience.

The amount of line built and maintained by the companies operating the Bell system averages 3.29 miles to each instrument, and, excluding the long-distance lines, fifty per cent of the wire is underground. When a call is made, the average amount of line placed at the disposal of the person who makes it is 6.58 miles. That anything like intercommunication is possible becomes the more a cause for wonder when it is remembered that the modern switchboard is a marvel of complexity in design and construction. It is the evolution of a quarter of a century, resulting from the collaboration of many experts working together for a purpose. Its mechanical intricacy will be better appreciated when it is remembered that even with the advantage of modern machinery and skill in manufacture it requires as long to build and install a switchboard as to build and equip a merchantman for foreign trade, the time being from one to two and a half years, and the cost varying from $500 to $600 per square foot for the smaller installations adequate for cities of 50,000 inhabitants, to $1,200 per square foot for the larger switchboards. The central station equipment, however, is but a small part of the whole cost of a telephone system, although it represents the greatest concentration of value in relatively small space. The life of a switchboard is usually short. Constant repairs, replacements, and extensions rapidly deteriorate it, and the effect of wear is distanced by the more rapid progress of invention and improvement. In a few years it becomes obsolete and the costly apparatus is burned to recover the copper it contains.

The result of systematic work in the perfection of appliances and the training of operatives has reduced within the past five years the average time of making complete local connections 3.9 seconds. This may appear to be a very little net gain, but as applied to all the telephone connections of the Bell system it amounts to 10,098 hours a day saved of the subscribers' time, or about three and nine-tenths years for each business day of eight hours. The system provides for 9,322,951 calls per day, or nearly 2,500 calls a year originating at each telephone in service. As one telephone is called for each one used, the average employment of each telephone in use is 5,000 times a year.

When one uses a long-distance telephone a large amount of property is placed at his service. For example, speaking from Boston to Omaha, as one business concern does every morning, the apparatus used, at the present price of copper, represents an investment of over $283,000, and it requires the service of nine skilled operators to make the necessary connections. The weight of the copper wire in the connection is 1,131,000 pounds, or 565½ tons, and it seems very like a miracle that the human voice can cause this immense mass of metal to vibrate in unison throughout its several parts, even to the delicate shades of tone which distinguish one voice from another, and that the instrument at the end is so sensitive that it can catch and repeat these vibrations and transmute them into articulate speech.

And it is all so new. Less than thirty years ago the telephone was an "overcapitalized" dream, and the stock of the Bell company could scarcely be quoted low enough to find a purchaser. Twenty years ago it was the luxury of the rich. What it has become in the past ten years we can best appreciate by reflecting what would happen if for any reason the telephone lines should be put out of use for a week.

Electrical Patents.

A new insulating material has been patented by Mr. George T. Pratt, of Westbrook, Me. The object of the invention is to produce a substance which will have a high degree of efficiency as an insulator and which shall at the same time have the necessary tensile strength, hardness and toughness and which shall be waterproof. The foundation of the material is leather pulp formed into a suitable sheet by any well-known means, the leather pulp having mixed with it a suitable strengthening fibre, such as sulphite wood pulp. In forming the sheet, preferably above seventy-five per cent of the leather pulp is mixed with about twenty-five per cent of sulphite pulp to give it the necessary tensile strength. The sheet is formed on a paper machine in the ordinary manner, and it is pressed lightly as it runs through the rolls, so that after being dried it will be as porous as possible, so as to retain as much as possible of the impregnating material. After the sheet is formed, it is dried and then dipped in the melted impregnating material, which in practice is composed of about seventy per cent of ozokerite or mineral wax, twenty per cent rosin, and ten per cent of alum, these last two ingredients being used to harden the ozokerite and give the necessary hardness to the material. An insulating material formed in this manner, it is asserted, is found to be very efficient.

Henry N. Potter, of New Rochelle, N. Y., has patented a new idea in glowers for electric lamps, which patent has been assigned to George Westinghouse, of Pittsburg, Pa. The aim is to provide a terminal, the metal portion of which shall cover a large amount of surface and every point of which shall be equidistant from a given point in the glower axis. On account of the extremely high temperature at which glowers of the character above indicated are operated, it has been found necessary to employ leading-in wires which are not only good conductors of electricity, but the material of which has a high melting point and is substantially non-oxidizable in the atmosphere. Platinum wire is usually employed for this purpose, and various methods of making connections between such wires and the ends of the glowers have been devised. As shown in the illustration, the left-hand terminal 2 is attached to the glower body 1, while the right-hand terminal is shown as detached. The terminal body 2 is shown as of frusto-conical form, having a recess 3 in its smaller end and as having an outer end 4 in the form of a segment of a sphere. This outer end is shown as provided with a cup-shaped spiral 5 of platinum wire, the inner end of which terminates in a leading-in wire 6, the spiral being either pressed into the body 2 of the terminal or fastened thereto by means of a suitable cement coating. The terminal may be of different shape from that specifically illustrated, and its metal portion may also differ structurally from what is shown, though the cup-form is desirable as is also an open-work formation of such other surface irregularity as shall ensure a secure gripping engagement between the metal and the body of normally non-conducting material. The end of the glower body 1 may be inserted in the recess 3 in the end of the terminal 2 and be cemented therein by a paste of material like or similar to that of the glower body, or a paste formed of such material and certain salts which will calcine when heated—such, for example, as one or more oxychlorides or nitrates of suitable metal. Instead of forming the terminal bodies 2 separately from the glower body 1 and cementing them in position, the entire glower structure may of course be moulded in a single piece,

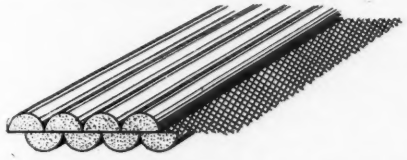
TERMINAL FOR ELECTRIC LAMP GLOWERS.

or the glower may be moulded in two parts and fused together after being roasted, or the bodies 2 may be cemented or fused directly to the ends of the glower body without the recesses 3. In fact, any known and practicable method of construction may be employed, the essential feature of the invention residing in the distribution of the metal portion of the terminal, so that every part of it shall be substantially equidistant from a given point in the axis of the body of the glower, whereby the current flowing into the glower will be distributed over a large surface instead of being confined to a single point or other comparatively small surface, and all parts of the terminal shall perform substantially the same service.

Many substances, especially those which have a high evaporating point—such as the oxides of calcium, magnesium and strontium, and other alkaline earths—have been introduced into the ordinary electrodes as used in arc lighting with a view to increasing the luminous efficiency of the arc. In some cases such substances will form deposits after having passed through the arc, which, gradually accumulating, form rings obstructing the emission of light. Mr. Hugo Bremer, residing in Neheim, Germany, has found that the slag can be rendered harmless by adding to the carbon a suitable quantity of a flux, such as boric acid, silica (silicic acid), or an alkaline borate of silicate or sodium chloride, these substances having the property of fusing at the temperature of the arc and then absorbing the basic slag by forming a borate or silicate or a luminiferous metallic base, which falls off in drops or small particles. Instead of adding a metallic base and a flux to the carbon separately, they may be chemically combined before they are mixed with the carbon. In other words, a borate or a silicate of a metallic base may be used. As the nature of a flux is well known, for instance, in ceramic arts, and in the working of blast furnaces, and depends, of course, on the particular material which it is intended to liquefy or absorb, it will not be necessary or practicable to specify every substance that may be used as a flux in the manufacture of carbons containing luminiferous mineral matter. In other words, as soon as the composition of the luminiferous mineral matter in the carbon is known a chemist acquainted with ceramic or glass industry will also know what materials may be used as a flux for that particular kind of carbon. The quantity of luminiferous mineral matter to be mixed with the carbon may be from ten to fifty per cent of the mixture of material from which the carbon electrodes are made, preferably from twenty-five to thirty per cent. The quantity of the flux depends partly upon the nature and quantity of the luminiferous base and partly on the nature of the flux. The total quantity of mineral matter contained in the carbon—that is to say, the luminiferous salts and the flux—should be at least twenty per cent, and not more than eighty per cent, of the carbon mixture, or from one-fourth to four times the quantity of carbon used. A higher percentage would be too detrimental to the strength of the electrode and to the temperature of the arc. On the other hand, if the quantity of luminiferous mineral matter is much smaller than those specified above, as has been the case in the earlier attempts, the least inequality of distribution causes considerable fluctuation of the arc, because the particles of mineral matter are placed far apart and cause a sudden flicker when the arc reaches the same. For this reason and others such carbons have not come into extensive use. If the slag produced

by the burning of the upper carbons forms a viscous liquid which falls off in drops and if the lower carbon is uncoated, the drops which fall upon the edge of the lower carbon will adhere to the same and the consecutive drops will gradually form on the edge of the lower carbon a ring which interferes with the burning of the carbon, as well as with the emission of light. If, however, the lower electrode has a glassy coating of borax, a silicate, or other suitable material, the drops of slag from the upper electrode will congeal immediately after they have separated and will slide down along the lower carbon without producing any injurious effect.

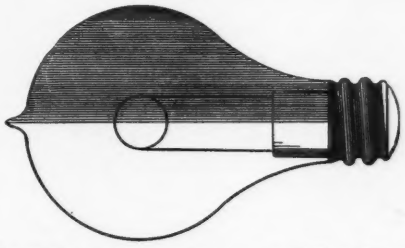
Mr. Johanne Justus, of Berlin-Halensee, Germany, has patented in this country a process of manufacturing plates of insulating material. Single bars of insulating material are first pressed out of suitable substance and are preferably of semi-circular or segmental section. These bars are then laid on their flat sides, closely side by side, and against a flexible



View of a Number of Insulating Bars Joined Together by Means of Pressure on Both Sides the Wire Fabric.

foundation, such as wide-meshed wire fabric. They are united with the fabric by pressure or the use of an adhesive. The insulating substance may also be provided to the other side of the flexible foundation or wire fabric, whereby an entire covering of the wire fabric is obtained, together with a better connection of the insulating bars therewith. The plates formed of these semi-circular bars have, owing to the rounded groove or furrow between the separate bars, great flexibility which renders them very suitable for encasing strongly curved bodies. Preferably, the bars are so located that those lying against one side of the fabric alternate with those bearing against the opposite side, and, consequently, an insulating plate of wavy or corrugated section is formed having a central foundation of wire which is of uniform strength.

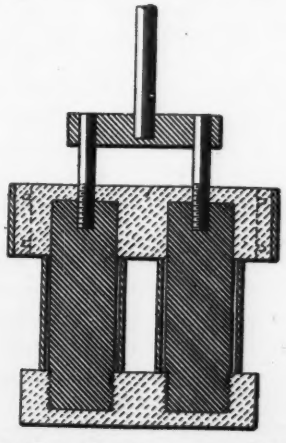
A new process of coating glass or fabrics has been devised by Mr. Henry Keppler, of Brooklyn, N. Y. In carrying out this process, a luminous powder is first mixed in medium bronze lacquer and applied evenly over the surface of the glass. This gives the surface a frosted appearance, and by reason of the illuminating properties of the composition thus formed when applied to one-half of a light globe acts as a reflector. The lacquer serves, of course, to form an adhesive base for the powder. The second step is to mercerize



Showing an Application of the New Coating for Glass or Fabrics.

white rubbing-varnish and apply this evenly over the first mixture, after the latter has been thoroughly dried. The third step is to dust this surface before drying with gold-bronze powder. The surface is then dried, and finally the article thus coated is subjected to a copper bath, after which it may be painted or enameled. When this process has been applied to an electric light or other globe, it will be apparent that the portion thus treated will be entirely opaque and that the inner surface of said coating will act as a reflector.

Charles E. Acker, of Niagara Falls, N. Y., has patented a carbon electrode and conductor, designed particularly for use in those electrolytic operations in which high-current densities are employed. There is provided a carbon block, the lower active surface of which is corrugated or grooved so as to permit the ready escape of evolved gases. These grooves are deepened somewhat toward the periphery of the electrode, affording upwardly inclined surfaces, along which



Showing Vertical Section of Electrode, Wherein a Plurality of Conductors Are Applied to a Single Block.

the gases may readily travel. In addition to affording paths of escape, the grooves serve to increase the active surface of the electrode in contact with the electrolyte. A carbon shank is secured to the block by screw threads or by dovetailing, or in any other suitable manner, and a metallic conductor is screwed to the end of the shank opposite the electrode. The carbon shank is protected by a tube or shell surrounding the same and constructed of fire-clay or other refractory material which prevents access of atmospheric oxygen to the heated carbon. This tube or sheath is supported upon the carbon block and may be let into the upper face thereof. If desired, a plurality of shanks may be employed for each block and these shanks can be connected by metal rods to a common metallic conductor. It is desirable also to protect the juncture between the carbon shank and the metallic conductor, and this is effected by means of a casing formed of soapstone slabs connected by plates or grids, the casing being filled with cement. This refractory casing is of somewhat greater area than the carbon block, and when the series of electrodes are assembled in the furnace, the casings constitute a cover which substantially prevents loss of heat and escape of gas. Furthermore, when so assembled, although the casings are in contact, the carbon blocks are sufficiently spaced to permit the furnace charge being fed between them.

Annual Report of the United States Commissioner of Education.

Vol. i of the report of the United States Commissioner of Education has been issued. This is a large volume of about 1,200 pages, and gives some very complete statistics of the state school system, the laws relating to land grant colleges, a discussion of Franklin's influence on American education, and a number of addresses on educational subjects. The educational systems of Canada and European countries are considered, and many statistics on various phases of the subject are included.

The Electrical Trades Society of New York.

The eighth annual meeting of the Electrical Trades Society, of New York, will be held on Tuesday, December 8, 1903, at Muschenheim's "Arena," 41 West Thirty-first street, New York city, at six o'clock P. M. There will be reports read, addresses, and the regular election of officers. An informal dinner will follow the annual meeting at 7.30 P. M. The dinner tickets are $2 each. Mr. A. P. Eckert, the secretary of the society, has issued a cordial invitation to all of the members to attend this dinner. All arrangements must be made in advance, and the secretary announces that he will be glad to hear from the members at the earliest possible moment.

Reviews of Current Engineering and Scientific Literature.

A High-Lift Centrifugal Pumping Plant for the De Beers Mines.

Two high-lift centrifugal pumps, operated by three-phase induction motors, have been installed by the de Beers Mining Company, of South Africa. One of the pumps contains four chambers and is designed to lift 1,000 gallons of water per minute against a total head of 320 feet. The pump is driven through a flexible coupling by a three-phase induction motor, taking power from a fifty-cycle circuit at a pressure of 220 volts, and giving 150 horse-power at 730 revolutions per minute. This motor is started by a water rheostat. The second high-lift pump has two chambers, and is arranged to lift 1,000 gallons of water per minute against a total head of 160 feet. It is driven by a three-phase induction motor giving seventy-five horse-power at 730 revolutions per minute. In designing these motors, a high efficiency was sought, because when installed in the mine ventilation would be poor and the work would be continuous.—*Abstracted from the Mechanical Engineer (London), November* 14.

Field Telephone Switchboard of the United States Signal Corps.

The switchboard developed for use in the United States Signal Corps in field work is here described by Mr. Harold Cramer. The switchboard for this class of work must be small, compact and portable. A ten-line switchboard, with its complete equipment, is contained in a stout wooden box fifteen inches high, fourteen and one-half inches wide, nine and one-half inches deep, weighing, completely equipped for service, about thirty-four pounds. The equipment consists of ten 500-ohm tubular drops, ten ringing keys, thirty connecting keys, three listening keys, combined receiver and transmitter for the operator's set, an operator's coil, a magneto hand generator, a night bell and a switch, together with four cells of dry battery. The equipment was mounted on a hard-rubber panel set in the front of the box, the drops being mounted in one row at the top of the panel, with the ringing keys directly below them and the connecting keys in three rows ten inches below the ringing keys. Three listening keys are mounted on the front of the board below the equipment already mentioned. The operation of any two connecting keys in the same row serves to connect together the lines to which the keys correspond. There can therefore be three separate connections through the board at the same time.—*Abstracted from the American Telephone Journal (New York), November* 21.

Electric Automobile Batteries for Quick Charge Rates.

The cause of buckling in accumulators is attributed by Mr. E. Kilburn Scott to poor mechanical design. The men responsible for these types have been too much the electrician, and too little the engineer. The author has investigated some recent types of accumulator designed for rapid charging. One of these, the Elièson, has its plate formed of strips of lead, alternately straight and crimped. They are united together by a central core of lead, from each side of which the strips extend like the hairs of a feather. At the top and bottom, cross pieces of wood give support to the ribs. As the strips are held at one end only, the oxidized material is free to expand and contract, and buckling is avoided. A cell containing three such negatives and two positives, measuring eight inches by five and one-half inches by three-eighths inch, and weighing twenty-two and one-half pounds complete with acid, is rated at 115 hours capacity at a five-hour discharge rate. Under test this cell, when nearly charged, was discharged at a rate of twenty amperes down to a voltage on no load of 1.5. It was then completely charged in seventy-five minutes, commencing at a rate of 120 amperes and finishing at a rate of forty-five amperes, the total charge being 110.69 ampere-hours. It was again discharged at the twenty-ampere rate and continued until the voltage dropped to 1.5, the discharge capacity being in this case 101.66 ampere-hours, showing an ampere-hour efficiency of approximately ninety-two per cent. The discharge was then continued at the rate of twenty amperes until only 0.5 volt was registered. The cell was short-circuited and left for forty-eight hours. A charge of 120 ampere-hours was again made in one hour, the rate for about twenty minutes being nearly 150 amperes. An extra forty-ampere-hour charge was then made in one hour, and the cell left for four days. At the end of this time the discharge made at the high rate was fifty amperes for one and one-half hours, and for a further forty-five minutes, at lower rates, showed a capacity of 106 ampere-hours, demonstrating that no loss of capacity had been caused by severe usage. Sir W. H. Preece tested a similar five-plate cell, and found it could easily absorb its charge in three-quarters of an hour.—*Abstracted from the Electrical Engineer (London), November* 13.

The Work of the Reichsanstalt.

This article gives a summary of the work of the Physikalisch-Technische Reichsanstalt, of Charlottenburg, during the year 1902. Much important electrical work has been done. Many thermal and conductivity tests of many metals have been made. The results in the case of cadmium point to a straight line law for the connection between the temperature and electric conductivity of pure cadmium. Measurements of electrolytic conductivity have been extended. The temperature coefficients of the ionic mobilities appear in the case of monovalent monoatomic ions to be functions of the ionic mobilities. Official testing stations have been opened at Ilmenau, Hamburg, Munich, Chemnitz and Frankfort-on-Main. These distribute fully tested instruments in different workshops, where they are in practical use, and verify them at intervals. Alternating-current measurements are still made by the quadrant electrometer. Motor tests have been made with brakes which give results agreeing with those computed by Heyland's diagram. Experiments on the various current losses in motors, made after the methods of Dettmar, Hummel, Kapp and others, did not give concordant results. Of the 127 Clark cells, ninety-five were certified. Twenty-eight were rejected because they deviated by more than 0.001 volt from the normal value, 1.4328. A new charge in regard to the inconstancy of the Weston cells has been disproved by Steinwehr. Fifty cadmium cells, prepared in 1900 by the Reichsanstalt, have been compared with those made in previous years, but the older cells now show 0.0001 volt too low. Methods of testing iron have been investigated, and a simple relation has been established between the

coercive force, remanence and maximum permeability. Thirteen thermo couples used as electrical thermometers, have been returned for retesting. Most of the thirteen were found unchanged, though they had been put to hard use. One of these had been in use since 1896, exposed to the flue gases and flames of a boiler. This indicated eight degrees too low at 1,100 degrees. Another, used in a coke oven flue since 1897, indicated seventeen degrees too low at 1,000 degrees. These were the worst cases, and in both of them the soldered joints had been repeatedly renewed.—*Abstracted from Engineering (London), November* 13.

Measurements of the Frequency of Very Rapidly Alternating Currents.

A paper published a year ago by Mr. J. W. Salmonson gave the results of some careful measurements of high-frequency currents. As these results have been questioned, Mr. Salmonson has devised a method for testing the accuracy of his previous work. An arc lamp is shunted by a condenser and an inductance, the latter consisting of the primary of an induction apparatus of the Dubois-Reymond type, from which the iron core has been removed. The secondary circuit of the induction coil is completed by a hot wire galvanometer and a mica condenser in series. If periodic currents are generated in one of the circuits, by establishing a singing arc, an impressed electromotive force will be set up in the secondary circuit, which will have the same frequency as that of the primary current. By varying the constants of the secondary circuit, it may be brought into resonance; and if the values of the inductance and capacity are known, the frequency of the current can be calculated. For these tests the inductance was carefully determined, and a condenser with a variable capacity was used. In this way sinusoidal currents with a frequency of more than 400,000 cycles per second have been produced. Up to 100,000 per second the results agree with those obtained by Peukert's method. The author thinks that his results show that, under certain conditions, the resistance of the electric arc remains negative, even at high frequencies, and this being the case, he does not see why a frequency of a million or more might not be reached. For getting these high frequencies the voltage of the arc should be as low as thirty-five, and the arc itself should be only a few tenths of a millimetre in length. To verify the results obtained by this method, photographs of the arc were taken by means of a rotating mirror. The results agreed with those computed from the constants of the circuit. The author thinks that the seeming discrepancy between his results and those of his critic is caused by the fact that there seems to be a critical potential difference at the carbons, or a critical length of arc above which the resistance of the arc ceases to be negative. With small frequencies this critical potential difference may be as high as forty-two to fifty volts, while with higher frequencies the critical potential difference is lowered, until, with the highest obtainable frequencies, it is not more than about thirty-five volts.—*Abstracted from the Electrician (London), November* 13.

Recent Development of the Metropolitan Electric Supply Company's Installations.

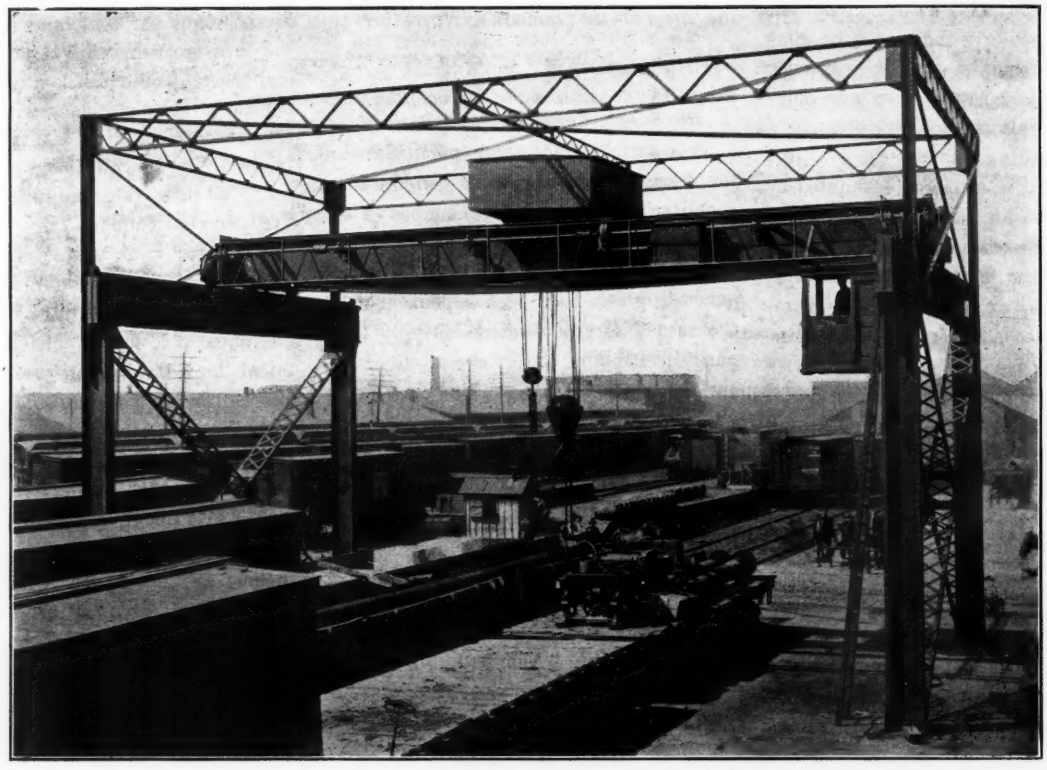
This article gives some particulars of the recent additions to the London Metropolitan Electric Supply Company's installation. At the Willesden station, two 1,500-kilowatt and two 3,000-kilowatt generating sets have been added. This is the second largest electrical supply company in London, the total output of the various stations being rated at nearly 23,000 kilowatts. The station building, as originally designed, was too low for the new units, and to accommodate them the floor was lowered ten feet. The 1,500-kilowatt sets are similar to those previously installed. The engines for the new 3,000-kilowatt units were supplied by Sulzer Brothers, of Winterthur, and the engines by Kolben & Company, of Prague. They are of the vertical compound type, with one high-pressure and two low-pressure cylinders. They are designed to give a full output with saturated steam at 150 pounds per square inch, either condensing or non-condensing, at a speed of seventy-five revolutions per minute. They are guaranteed to give the following results with dry or saturated steam: at full load, the steam consumption per indicated horse-power-hour will be fifteen pounds, and the mechanical efficiency, excluding auxiliaries, will be 92.5 per cent; at three-quarters full load, the steam consumption per indicated horse-power-hour will be fourteen pounds and the mechanical efficiency ninety per cent; at one-half full load, with a consumption of fourteen pounds of steam per indicated horse-power-hour, the mechanical efficiency will be eighty-six per cent. It is thought that the steam consumption will be reduced about one and one-half pounds per indicated horse-power-hour when superheated sixty-five degrees centigrade. The engine can easily carry an overload of twenty-five per cent under normal conditions. The generators are of the two-phase type with revolving fields, rated at 3,500 kilowatts each at 10,000 volts, sixty cycles per second. They will give 3,000 kilowatts at any voltage between 10,000 and 11,500, and will carry a non-inductive load of 3,000 kilowatts at 11,000 volts for twenty-four hours with a temperature rise not exceeding degrees Fahrenheit. They will also carry an overload of twenty-five per cent for four hours. The pressure drop at constant speed and excitation does not exceed eight per cent, and by calculation the pressure drop with a power-factor of eighty-five would be less than eighteen per cent. The efficiency with non-inductive loads, including excitation and air friction, is, at full load, ninety-six per cent; at three-quarters full load, ninety-five per cent, and at one-half full load, ninety-three per cent. The armature spider, of steel, carries ninety-six poles of soft cast steel of elliptical section with laminated pole shoes. The cores are dovetailed into the periphery of the wheel, and can be slipped out sidewise complete with the windings. Each alternator carries its exciter on an extension of the main shaft. The bore of the armature is 300 inches, and the air-gap is 0.315 inch. The gross width of the armature core is 29.1 inches; the net width, 21.5 inches, and the depth of core, 7.2 inches. There are 576 slots, each containing ten conductors. These are connected in two parallel circuits, each containing five conductors in series. The section of the pole cores is 80.5 square inches; the dimensions of the pole shoes, 29.1 by 6.5 inches, and there are thirty turns per pole. The switch gear is of the Ferranti type, and in the boiler house, six Babcock & Wilcox boilers have been installed. At the Amberly road substation twenty-one transformers, each rated at 100 kilowatts, have been installed. These are mounted on wheels, so that each can be drawn out of the bank for inspection. Each transformer has a regulating switch whereby the pressure on the secondary bus-bars, which work at 1,000 volts, may be varied by 120 volts in twelve steps.—*Abstracted from the Electrical Review (London), November* 13.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

A Heavy Service Overhead Electric Traveling Crane.

The following illustration shows the latest type of an approved and economical apparatus for the handling of heavy and bulky freight in a railroad yard. The illustration shows a portion of the yard of the Buffalo & Allegheny Valley Division of the Pennsylvania Railroad Company, and includes a forty-ton Niles overhead electric traveling crane, forty-eight-foot span, and a substantial structural steel runway forty feet long. The crane spans three tracks, and leaves a wide passageway which gives ample approach for teams and trucks on one side of the cars covered by this apparatus. In addition to the main hook, a quick running auxiliary hook of five tons capacity is provided for the rapid and efficient handling of light loads, which performs by far the greater part of the service of the crane. The bridge consists of two heavy curved girders, of box section. It is driven longitudinally on the runway, by motor located on the front girder which is geared to the truck wheels on either side, the motion being controlled by a foot brake located in the operator's cage which acts directly upon the armature shaft of the motor. A foot bridge is provided the entire length of the span, with customary guard rail. The bridge trucks are securely fastened with the utmost rigidity to the girders, provided with heavy cast steel, double flanged truck wheels with threads accurately finished to uniform diameter. The trolley is the standard type used on overhead cranes, consisting of heavy side frames securely bolted together and kept in perfect alignment by a separator. All the gearing is cut from the solid and runs encased in oil, which gives the entire mechanism an unusually high mechanical efficiency. Both hoists are provided with mechanical and electric brakes, also circuit-breaker and limit switches to prevent overwinding and consequent damage to the crane or its load. The trolley, operator's cage and bridge-drive motor are of the enclosed type, affording suitable protection from the weather. The runway is built up very substantially. It consists of four columns carrying runways of riveted plate and channel construction, and is laterally braced. It will be readily appreciated that an equipment of this character has a much greater capacity than the average pillar or swinging crane which is usually installed at railroad freight stations. If at any time it is desired to cover increased acreage by the hook, the length of runway is readily increased by adding additional spans. This crane is notable because of the extra height of lift, which enables the loaded hook to clear the top of box cars or other obstructions while performing the functions of its regular service of loading and unloading. The complete apparatus was manufactured, installed and erected by the crane department of the Niles-Bement-Pond Company, Meadow and Mifflin streets, Philadelphia, Pa.



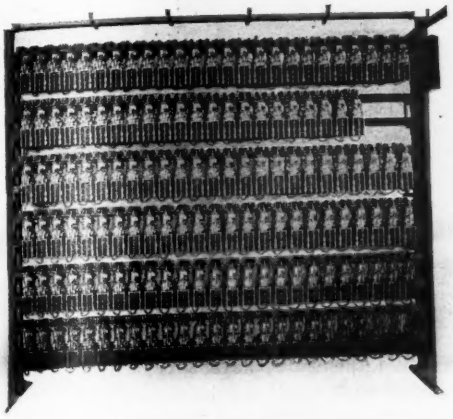
SHOWING FORTY-TON NILES OVERHEAD ELECTRIC TRAVELING CRANE, FORTY-EIGHT-FOOT SPAN, LOCATED IN THE BUFFALO & ALLEGHENY VALLEY DIVISION FREIGHT YARD OF THE PENNSYLVANIA RAILROAD COMPANY.

Wireless Telegraph Experiments.

Professor Alexandro Artom, of the Royal Industrial Museum, Turin, is reported to have been successful in carrying on wireless telegraphic communication simultaneously between two pairs of stations in the same locality. Experiments were made for a distance of thirty-five miles, near Rome. Professor Artom is said to have employed a special instrument of his own invention in these experiments.

Latest Type Automatic Telephone Switchboard.

The Automatic Electric Company has recently made a change in its method of mounting the switches at the central station in that it uses steel angles for the switch shelves instead of wood. The accompanying illustration shows an automatic switchboard of the latest type with



NEW TYPE STEEL FRAME AUTOMATIC TELEPHONE SWITCHBOARD.

the switches mounted upon steel frames. The illustration is taken from a six-shelf switchboard, a section of an exchange of 10,000 stations. It has been found that the steel mounting is more rigid and no heavier than the wood, and there is no sagging in the shelf on account of the weight of the switches. Two light strips of wood are used in the rear of each shelf angle for the purpose of insulating, and with this exception there is no wood on the switchboard. This method of construction is not only more modern, but gives to the switchboard a neater appearance.

Machine vs. Hand Numbering in Metals.

The operation of numbering name-plates and metal parts has, until recently, remained a most unsatisfactory one, and the old method of employing individual figure stamps and hammer was not only crude, slow and expensive, but errors and irregularities constantly occurred and the appearance of the work was far from attractive. The machines here described are designed with a view of meeting every requirement—eliminating the many difficulties which have heretofore existed and performing in an hour what was before considered a good day's work, enhancing, rather than destroying, the appearance of the parts upon which a number is to be placed. By their use consecutive numbering is accomplished with absolute accuracy, and any numbers which skip backward or forward, such as type and voltage numbers, may be impressed on the parts themselves, or upon tags or plates to be attached to them. These machines are already in use to such an extent that the maker states that their practicability has been fully successfully tested, while it has been demonstrated that they are important factors in the saving of labor.

Fig. 1 shows the new model No. 43 which is designed for consecutively numbering gold, silver, steel, brass, copper, iron, tin, hard rubber, fibre, leather-covered and wooden instruments or parts of any kind, size or shape, such as name-plates, sewing machine slides, iron castings, electric, gas and water-meter tags, brass checks, steel keys, locks, watch cases, watch movements, steel bars, plates, etc.

It may be operated in any punch, screw or lever press. The shank is made straight or to any taper and length desired. It is set up in the same manner as an ordinary punch, but the stroke of the press must be limited and carefully adjusted to the depth of the impression required.

As the discs revolve, the figures are brought into correct alignment, are equally spaced apart and all are sunk pre-

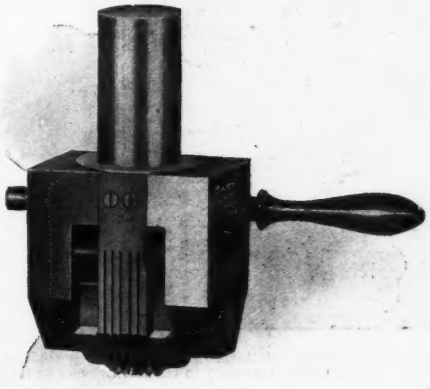


FIG. 1.—FOR CONSECUTIVE NUMBERING.

cisely the same depth, thus ensuring perfect uniformity. The lever-bar may be attached to any stationary part of the press, and the number will then advance automatically in consecutive order with each stroke. The figures and letters are made to any size or style desired, and are cut upon "tool steel" wheels, carefully hardened and tempered.

Fig. 2 shows the new model No. 44 which is designed for stamping the style, size, grade, type, ampere, voltage and power numbers upon name-plates, tags or parts of motors, dynamos, electric meters, etc. Any combination of letters and figures may be set instantly—skipping forward or backward—as is required for numbers which do not progress consecutively. Each numbering disc or wheel is provided with a lever which operates it independently of the others. The ends of these levers form a small keyboard. Remarkable speed is invariably attained as soon as the operator becomes practised. This experience is very easily acquired by an ordinary machine hand. The figures or letters which are in stamping position are always shown by the indicators on the front of the wheels just below the keyboard.

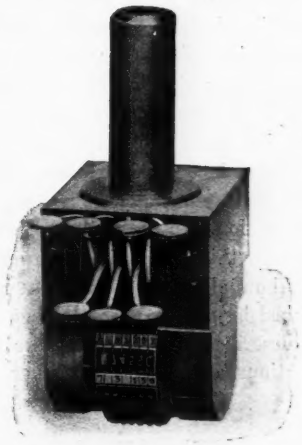


FIG. 2.—FOR COMBINATION NUMBERING.

Fig. 3 shows the new model No. 34 which is designed to facilitate the operation of models Nos. 42 and 43, but any punch, screw or lever press may be utilized. Adjustment gauges are usually provided to which the pieces or parts to be numbered are fed. A toggle joint ensures maximum power with comparatively slight pressure upon the lever. A model No. 43 consecutive machine is shown in the illustration.

A catalogue describing these machines

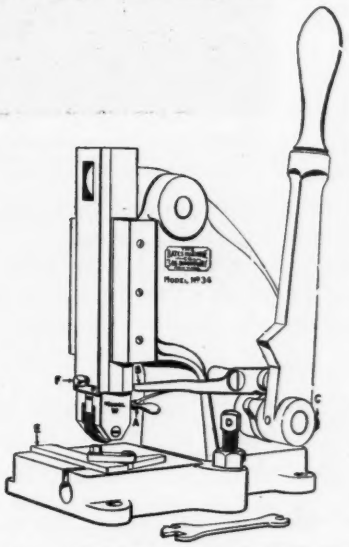
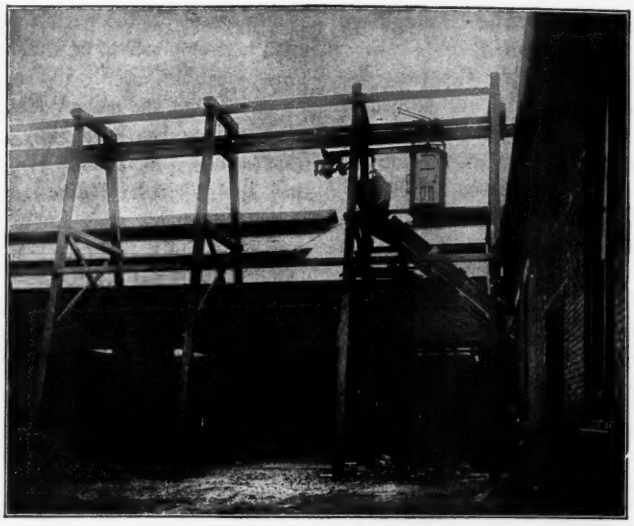


FIG. 3.—AUXILIARY PRESS FOR NUMBERERS.

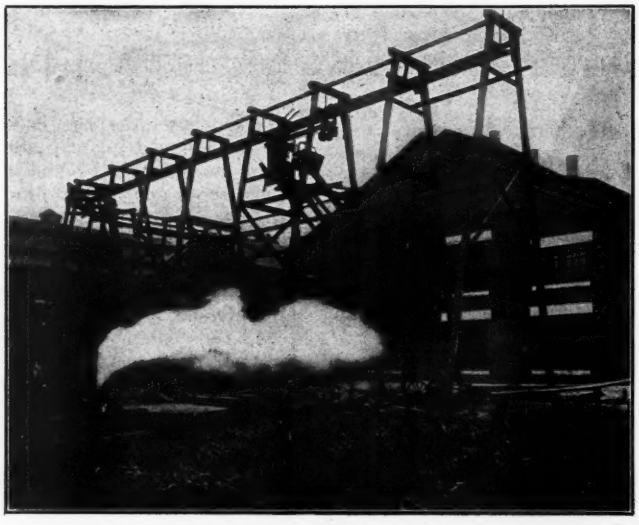
will be forwarded upon request to the maker, the Bates Machine Company, who is widely and most favorably known as a manufacturer of high-grade numbering machines. The general offices are located at 346 Broadway, New York, and it has branches in Manchester, England, and in Brussels, Belgium.

Telpherage in Coal Handling.

The large quantities of coal being consumed by gas companies, railroads, waterworks, electric railways, electric light companies and manufacturers make it imperative that a storage should be provided of sufficient capacity to forestall any scarcity that may occur from any cause. The model coal storage is such that either anthracite, bituminous or run of mine coal may be received either by boat or rail, placed in the storage, and then removed with great rapidity and with a minimum of labor and expense, crushed and delivered to the boiler houses or places of consumption. In the method of storing indicated in this article, it is the purpose to show how all these points may be accomplished by means of the telpher. One type is described of which there are many modifications. The same machinery, telpher and hoist may be used for removing ashes as well as storing the coal.



Telpherage unloads the ships at wharf, the car on siding; deposits the coal in elevated coal pocket or bins and on the storage ground; charges the water gas retort with but one handling; receives the coke from the quencher a few feet from the ground, and places in a pocket and upon screens or in crushers forty feet from the ground. One man attends to all the hoisting, conveying and depositing.

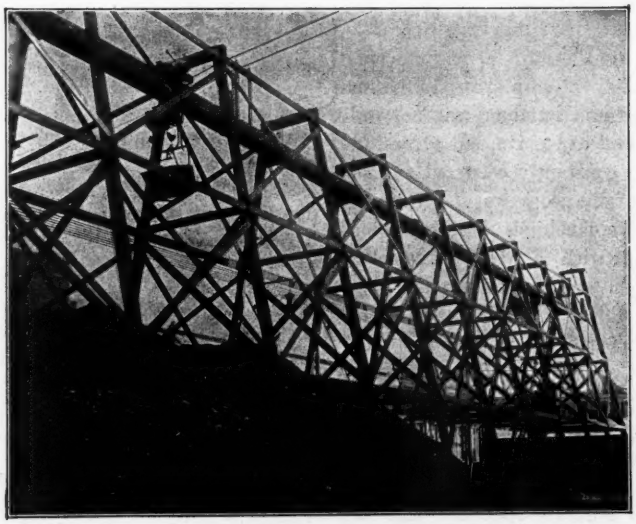


An example of exceedingly high bents or supports to pass over intervening buildings. For raising coal or coke to a height and dumping the same over screens and distributing into chutes. One man in the cab attends to the whole work of elevating, transporting and distributing.

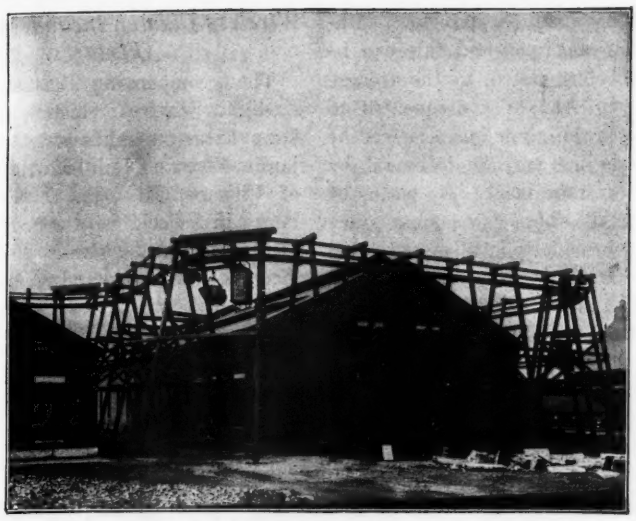
Coal may be removed from boats by unloading towers, either movable or stationary, of the standard type used for such work, or by means of projecting track. In this latter form the telpher must run out over the boats on the projecting track, and, by means of its hoist and bucket, take its load direct from the vessel.

In case conveying alone is desired, a telpher with a train of buckets is used, and after the buckets have been loaded from the hoppers in the towers travels to the storage yard, where the load is discharged, and then returns for another load. The hopper which is higher than the telpher track, feeds the coal into the buckets, which are generally bottom dumping. These four buckets, which constitute the train, have a capacity of two tons each, and can be fed by four chutes from the same hopper simultaneously, or by one chute, the train being moved along as each one is filled. In the first case much less time is consumed. The entire eight tons conveyed in this train are handled by one man, who is stationed in the cab. By means of a controller of a special type, he may start the train or stop it at any desired point, and by means of a wheel or lever at the end of the bucket may dump the entire load without moving from his seat or losing time. This is due to the fact that the entire number of buckets are coupled together by universal couplings.

Should it be desired to take from storage, the telphers are fitted with grab or clam-shell buckets and hoists.



The track is elevated upon exceedingly high bents for the storage of thousands of tons of coal within a limited area. The line is automatic, being controlled from the terminal. The trestle is strongly braced and built to withstand the pressure of the coal.



A sixty-foot vertical lift of 3,000 pounds; a sinuous run of several thousand feet at 1,200 feet per minute; a deposit at the end of the run and at intermediate points, on the ground or fifty feet above.

In special storage unloading towers are provided on the docks similar to those before mentioned. The track is laid out in such a manner that there need be no fear of congestion at any time, in case it is desired to run a number of trains over the system. In fact, the number of trains, which can be made longer if necessary, can be so arranged as to present an almost continuous line of two-ton buckets. This gives a very good idea of the great capacity of the telpherage system.

The telpher train receives its coal from the towers, proceeds along the telpher track, around the large circle which forms the storage yard, thence to the crushers, delivers its coal and returns. If, however, it is desired only to store the coal, then the telpher passes from the towers, across the rotary telpher tracks, dumps the coal and returns by the other side. As soon as the coal is piled up to the proper height, the tracks are then moved, say five to ten feet, and the process is repeated. In this way the top of the coal is left practically level and all the space utilized. It will be noted that in the centre of the storage space is placed a pedestal for the large rotating telpher tracks. These are supported in the middle by the pedestal, and the ends are allowed to move upon the circular track, making what might be called a continuous moving switch. By means of these the coal can be taken from the towers and dumped into storage yard, while at the same time other telphers, by means of clam-shell buckets, take the coal from the storage and carry

Coal from cars to reserve storage, and from reserve storage to gas works and boiler house. Automatic plant with cable track.

The bucket is lowered open upon the coal or like divisible material, "grabs" the same, and the electric hoist closes the bucket and elevates the load, while the Telpher does the conveying. Telpher upon a curve works equally well upon a grade. Load with bucket, three tons. Speed, 1,000 feet per minute. Electricity does the work of eighteen men, one man directing.

it to the crushers or the retorts. It will therefore be seen that by means of this rotary movement, effected either by electricity or by hand, according to the size of the telpher or the frequency of movement, gives us the command of the entire area within the large storage space. As stated above, should it be deemed advisable, however, to go direct to the crusher, it can easily be accomplished by revolving this rotating telpher track until it assumes the second position; then the telphers go direct to the crushers.

The method of taking from storage is practically the same as placing in storage, the only difference being that the telphers are supplied with clam-shell buckets and hoists. The same telphers can be used for taking coal from storage or from the cars. The telpher track runs parallel to the railroad tracks. The cars may then dump

into pits, thus enabling the clam-shell bucket to act more efficiently than if it takes out of the cars direct.

The principle involved in this lateral moving track is the same as in the rotating telpher track, the difference being, as their respective names imply, one rotates and the other travels laterally. In this last method the layout of the tracks takes the form of a rectangle. We will suppose it is desired to take coal from the railroad cars; we run the telpher alongside the railroad tracks, and take our supply either from the cars direct or from coal pits by means of clam-shell buckets, as before. This, however, could be a water front, where towers would be employed. The telpher takes its load and moves along the side of the rectangle, crosses on the movable telpher track, deposits its load at whatever point is deemed best by the telpherman, and returns for another load on the opposite side of the rectangle, thus preventing congestion in case two or more machines are employed. The lateral moving telpher track may be moved in any desired position, either by electricity or by hand, along the rectangle which forms the storage, thus allowing the telpher to cover every square foot of enclosed area. This storage may be extended at any time by simply adding more track on at the open end, thus lengthening the rectangle. It may be used inside of a coal shed, in which case the uprights of the shed may be used for supporting the lateral moving track and telpher track; these two methods may be employed in conjunction with each other or separately, as is most desirable. The telphers used in either of the methods can be run on either system.

The small number of moving parts to the telpher, namely, the motors, reduce the wear and tear to a minimum. The fact that it is all accomplished by electricity, and that the moment a machine is stopped no power is being expended, the entire system can, therefore, be shut down at a moment's notice; also the fact that one man can handle eight tons with ease, thus reducing manual labor to a minimum. The flexibility and adaptability of the system all go toward making it the ideal machine for handling any material at a low cost. The amount of knowledge required to operate one of these machines is not great, and can be learned by the average man in a few hours. The fact that the track is elevated gives an advantage over other systems for capacity, and, also, there being no danger of obstructions occurring, such as all surface lines are subject to. Speed can be developed without danger to any one, and this can be attained, as before stated, by the average man, with no fear of consequences to others by fast running or inexperience. At any time the line may be increased by merely adding more track. By means of projecting track, where it is not necessary to handle enormous quantities of coal a day, the unloading towers may be dispensed with, as in the case of barges, and projecting track be substituted, thus doing away with the two men in the unloading towers, and allowing the telpherman to run his machine out over the projecting track and lower the clam-shell bucket directly into the barge and hoist and convey the load away, dump, and return for another trip.

As the machines run on a standard T-rail, which it is well known by years of experience and experiment to be the best adapted to take up the wear of traction, the maker sums up the advantages of the telpher and telpherage as follows:

Simplicity of construction, few moving parts to wear, unlimited capacity, adaptability to all conditions, no more limit to length of line than would occur with a trolley road, low cost of maintenance, large reductions in manual labor, no skilled labor required, and freedom from all obstructions common to transportation.

By means of electricity, adapted and applied for conveying, with the same skill as employed in the electric street railway service, with portable electric hoists for elevating, most economical and satisfactory results have been achieved. In some of the views as given, self-dumping buckets are illustrated, but in other cases, where very large quantities of material are to be handled in a short time, clam-shell or grab buckets are shown. In this latter case the telpherman goes with the telpher and attends to the loading, hoisting, conveying and dumping the loads. It is interesting to note in one of the views that the material is to be dumped into a number of hoppers, showing its adaptability to dumping into chutes or openings, for filling coal bunkers on steamers, locomotive tenders, gas retorts or generators, coal hoppers, or other places where the coal or divisible material is to be dumped into a restricted space.

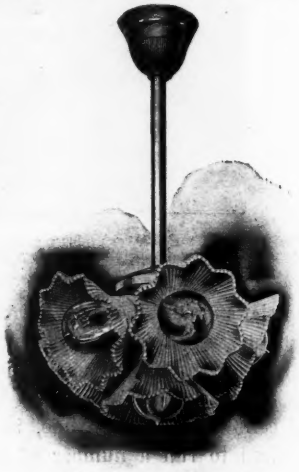
This apparatus is manufactured and installed by the United Telpherage Company, 20 Broad street, New York city.

Consolidation of Electric Light Companies in Milan.

At a meeting of the stockholders of the Società Fecnomasio Cabella, which was held at Milan, Italy, on October 4, 1903, it was decided to consolidate with the Società Italiana Brown, Boveri & Company, Milan, thus forming one large electric company in the city of Milan.

Wireless Cluster Incandescent Lamp Fixtures.

The accompanying illustration shows a six-light wireless cluster incandescent lamp fixture, manufactured by the Benjamin Electric Manufacturing Company, of Chicago, Ill. The cluster has five lamps in a circle, with one straight down at the end of the stem. The shades fit directly on the lamp and require no shade-



SIX-LIGHT CLUSTER INCANDESCENT LAMP FIXTURE.

holders, the effect being a hemisphere of light of ornamental appearance.

The Benjamin cluster is especially adapted for this class of work, the lamps being clustered closely together. The wireless feature, whereby only the stem wires are required, makes these clusters very desirable and the Benjamin company reports a heavy demand for this fixture.

It will be noted that this cluster is

DESK LIGHT EQUIPPED WITH HOLOPHANE GLOBE.

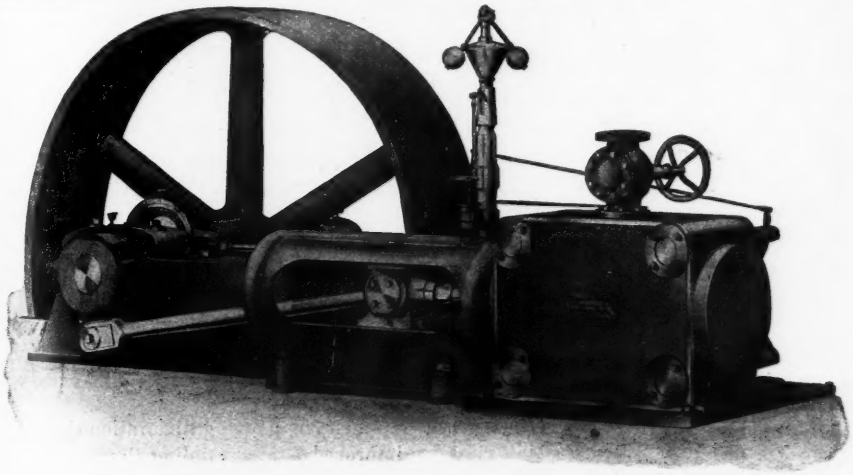
equipped with "Pagoda" shades, made by the Holophane Glass Company. These shades are very popular for all forms of lighting.

Another illustration shows a new desk light equipped with a Holophane globe. The New York office of the Benjamin Electric Manufacturing Company is at 27 Thames street, and V. R. Lansingh & Company is the Chicago sales agent of the Holophane Glass Company, at 18 East Adams street.

Allis-Chalmers Company's New Standard Reynolds-Corliss Engine.

The accompanying illustration shows a new Corliss engine which is being brought out by the Allis-Chalmers Company from the designs of Irving H. Reynolds.

Engines of the type illustrated are being built in seven sizes, ranging from 50 to 500 horse-power, and are designed for steam pressures up to 150 pounds. They are built of somewhat shorter strokes than



ALLIS-CHALMERS COMPANY'S NEW STANDARD REYNOLDS-CORLISS ENGINE.

have heretofore been customary in Corliss engines, with the idea of economizing in space and making the construction more rigid. The speeds are also somewhat higher than usual, ranging from 110 to 150 revolutions per minute, although these speeds are not higher than those at which the Reynolds-Corliss engines of older design are frequently operated.

The frame is cast in one piece with the slide, the construction being of the box type, resting on the foundation for its entire length. The main bearing shells are bored into the frame, thus ensuring a solid bearing and also permitting the easy removal of the shells by rolling them out around the shaft.

The slide is of the barrel type with bored guides. The crosshead is fitted with babbitt-faced shoes with wedge adjustment. The piston rod is screwed into the crosshead and held firmly with a steel lock nut. The cylinder is of the round-cornered type, is fitted with double-ported steam and exhaust valves, lagged with planished steel. The cylinder is set on a cast-iron base-plate, which extends under the valve gear, serving as a drip pan.

The valve gear is of the usual Reynolds-Corliss type, the wrist plate being of skeleton pattern and fitted with a new type of disconnecting device which, while clamping the hook rod firmly, is very easily detached by hand.

The dashpots are of differential plunger type without leathers or packing of any kind.

The regulator is of the high-speed, weighted type, designed to control the engine within narrow limits of speed variation.

The connecting rod is of steel with solid forged ends, fitted with bronze boxes, babbitt lined on the crank-pin ends, the boxes being adjustable by means of screw actuated wedges.

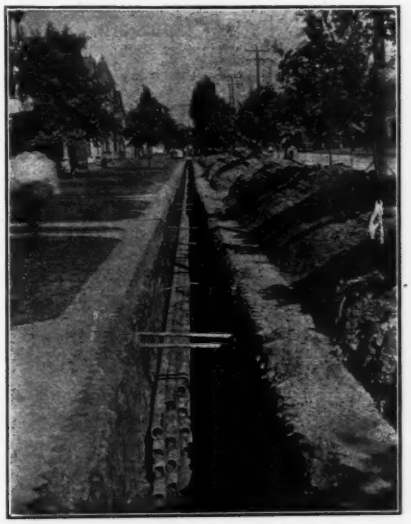
The crank is of plain type, polished on the face, and is protected by a planished steel oil guard.

The engines are fitted either with belt flywheels, as shown, or with square rim wheels where used with direct-connected electric generators. The crank and crosshead pins and main journals are of a size ordinarily used with heavy duty engines.

In brief, the engine is strong, simple and compact, and while nothing has been added for ornamentation, nothing contributing to economy or durability has been omitted, and the machine should find a large sale among power users who appreciate quality.

Conduit Systems.

An instance of modern conduit work is shown in the recently completed systems in Louisville, Ky., for the Louisville



UNCOVERED SECTION OF CONDUIT IN OPEN STREET.

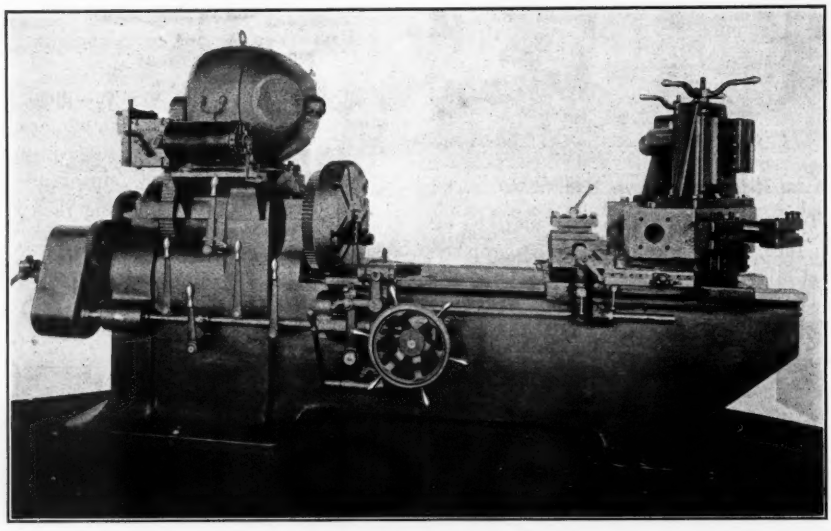
Street Railway, which was equipped for high or low tension, over 500,000 feet of duct being used. The system was equipped throughout with modern improvements, and the new Gest cable hanging rack and terminals were used. The contract for this system was given to G. M. Gest, New York city, N. Y., and was completed in ninety days from the time work was commenced.

CONDUIT TERMINAL, PARTITION AND CABLE-HANGER SLOTS.

Fig. 1 shows an uncovered section of the system running through one of the thoroughfares at Louisville, Ky. Fig. 2 shows a Gest terminal of the system. In relief is the concrete division wall which separates the two series of conduits, one running into a terminal duct and the other ready for continuation. To the right and left are the cable-hanging slots, a new improvement recently instituted by the contractor for this work.

A Heavy Turret Lathe.

In the accompanying illustration is shown a Conradson twenty-four-inch semi-automatic turret lathe. This machine is manufactured by the American Turret Lathe Manufacturing Company, of Warren, Pa., and is intended for heavier work than is usually imposed upon a turret lathe. It has a massive bed construction, a large turret and is designed to swing twenty-seven inches for a distance of twelve inches from the chuck. Twelve rates of spindle speed and eight feeds of the turret are possible with each speed of the motor. The gear combinations for all of these are protected and may be operated and effect a change in speed while the machine is running. The levers for the various gear clutches are shown under the head. The turret has universal facing heads and provides thirteen tool positions, though sel-



HEAVY MOTOR-DRIVEN TURRET LATHE.

dom more than five are used at one time. An auxiliary turret which will accommodate four tools and has power cross-feeds is on one side of the main turret. The latter has rapid power traverse in either direction afforded by a separate motor, and a slower travel through the feeding mechanism driven from the spindle. Rotating, indexing and clamping of the turret head are all automatic, and an independent "knockout," or feed stop, serves each face.

The spindle is driven through a Renold silent chain by a ten-horse-power Crocker-Wheeler semi-enclosed motor mounted above the headstocks. An M-12 controller in the current supply allows the motor twelve speeds, ranging from 876 to 130 revolutions per minute. With the combination of electrical and mechanical means the highest and lowest possible chuck speeds are ninety and one and one-fifth revolutions per minute, respectively. For the operation of the turret a three-horse-power Crocker-Wheeler fully enclosed motor is used. This runs continuously at a constant speed of 1,100 revolutions per minute on a two-wire supply and drives a steep-pitch lead screw through bevel gearing. A longitudinal shifting of the driven shaft clutches one or the other of two bevel gears producing direct or reverse rotation, or in the central position releases both.

The New Worthington Plant.

An extensive pump manufacturing plant, the largest in this country and probably in the world, is now under construction at Harrison, N. J. It is to be occupied by the firm of Henry R. Worthington, which employs about 3,000 men in its present works at South Brooklyn, L. I., and Elizabethport, N. J. The new plant at Harrison will accommodate from 4,000 to 5,000 men and will cost in the neighborhood of two million dollars. It consists of a main machine shop with side galleries over 1,006 feet long, an erecting shop 592 feet long and of the same section as the machine shop, and a high erecting shop 210 feet in length and four galleries in height in the side bays connecting the two shops. The main foundry is 600 feet in length and there is also a special foundry for small work 410 feet in length, with a building 200 by 60 feet in size for cleaning castings connecting the two. The pattern building is four stories high and 550 feet long, and is divided by wire walls into four sections. The north section will be used for offices and drafting rooms; the adjoining section for the pattern shop, and the balance of the structure for pattern storage. The power-house, which will be equipped with the most modern boilers, engines and generators, is a building 172 by 102 feet. Electric power distribution is to be employed throughout, and the grounds will be illuminated by electric arc lights. There are many other buildings which will be used for packing, storing and shipping goods, etc. The buildings are so arranged that additions can be built when the work demands it. All will be connected by a complete system of railroad tracks entering the ends of the buildings and placing the works in direct communication with the Delaware, Lackawanna & Western, the Erie and the Pennsylvania Railroad systems. The new plant will be devoted entirely to the manufacture of waterworks machinery, water meters, cooling towers, condensers, feed-water heaters, centrifugal pumps and steam pumps of all kinds.

An Improved Solid Expanding Sleeve.

The accompanying illustration shows the improved solid expanding sleeve manufactured by James S. Barron & Company,

SOLID EXPANDING SLEEVE.

New York city, N. Y. It is used principally for fastening telephone backboards, etc., to brick, stone and cement. The sleeve is made of one piece, and is equally suitable for screws with either wood or machine threads. The company furnishes the sleeves with or without screws, as desired.

A Novel Use for a Refrigerating Machine.

In some electrical tests, where exact results are required, it is important that certain instruments, or baths, or chambers, be maintained at a constant temperature, and in other tests it is quite necessary that the air be comparatively dry. To secure these desirable conditions in its new laboratories at Eightieth street and East End avenue, the Lamp Testing Bureau has installed a refrigerating machine which will cool the air of one room to the temperature required and freeze the moisture from the air of another room when the humidity is higher than it should be for the best working conditions.

The company hopes to have its new laboratories ready for work about January 1, when it will abandon its present temporary quarters at 14 Jay street, New York city.

Rapidity in Telephone Line Construction.

There is under construction at Lincoln, Neb., a Strowger automatic telephone system, which is expected to be completed and in operation by January 1, 1904. The installation consists of twenty-five miles of underground conduit, seventy miles of pole lines, thirteen miles of aerial cable, eleven miles of underground cable, 700 miles of overhead wires, and the installation of 3,000 Strowger automatic telephones; more than 150 carloads of material being used in the work.

PORTABLE POLE-RAISING DERRICK.

The contract for this installation was let to the General Engineering Company, of Chicago, and it has been encouraged to use its utmost speed in the completion of this plant, by the offer of a large bonus for each day saved under the time limit allowed by the contract. How well it has carried out the wishes of the Lincoln Telephone Company in this regard will be best understood by stating that ninety per cent of the work is now completed and the time elapsed since the beginning of the work is ninety-two working days.

A number of labor and time-saving devices have been designed that have contributed largely to the results secured. Among them may be mentioned a portable pole-raising derrick, which has a record of setting 102 poles, ranging from forty to fifty feet, in eight and one-half hours, with six men and one driver.

One of their devices which will at once attract the attention of practical telephone men is a portable power wince for drawing underground cable through their ducts. An illustration of this device is shown, the photograph having been taken just as a 450-foot pull of a 250-pair cable was being started. The fact that the machine here illustrated, though hastily constructed from plans prepared by the General Engineering Company, has pulled to date 50,000 feet of heavy underground cable, without a single accident and without a cent of repairs on the machine itself, would seem to warrant the most conservative telephone engineer in giving this device his careful consideration.

PORTABLE CABLE-PULLING APPARATUS.

A satisfactory machine for this service must be portable, self-containing, durable and of ample power, and the first cost and maintenance must not be excessive. The record this machine has made in Lincoln, together with the view here shown of it, seems to indicate that all of these conditions have been fulfilled. The weight complete, with water and gasoline tanks full, is less than 2,600 pounds. A single team handles it easily, and on paved streets it may be moved from manhole to manhole by four men. A gasoline engine is employed, and in this particular case the ignition spark is furnished by dry batteries, though the company recommends a regular sparking dynamo for the purpose. The engine develops six brake horse-power at 600 revolutions per minute, which is the normal speed. This is geared down to a cable speed at the drum of thirty feet per minute.

Considerable attention has been given to the friction clutch, which operates the hoisting drum, and to the strap brake. The arrangement is such that the friction clutch throws itself out, unless constantly held in position by an attendant. A very slight motion of the hand, requiring no appreciable strength, disengages the clutch, and the drum instantly ceases to revolve. This clutch enables the load to be picked up slowly and the speed gradually increased to the maximum, avoiding all undue strains on engine, hoist or cable.

The gears, shafting and bed-plate are extra heavy and all gears are protected. The consumption of gasoline is about two gallons per day, and this, with the addition of a little lubricating oil and the time of one attendant, represents the entire expense of operation.

A pull of 450 feet of 250-pair cable is made regularly in twenty minutes, and a crew of six men and one team has pulled 5,000 feet in one day with ease. The cable speed can, of course, be increased, but it is doubtful if it is safe to pull faster than thirty feet per minute. The hauling cable is of three-quarter-inch crucible steel rope, six-strand and hemp centre, nineteen wires to the strand.

In addition to its use as a cable-pulling machine, the General Engineering Company finds its gasoline engine a convenient tool for operating a concrete mixer, and for other applications about its plant.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

NEW ELECTRICAL BUILDING FOR NEWARK, N. J.—Plans and specifications have been prepared for a new thirteen-story building to be erected in Park Place, Newark, N. J., by the Public Service Corporation of New Jersey, and the contract will be awarded at an early date. The structure will be completed in about a year, and will cost more than $1,000,000. The building will be occupied entirely by the various departments of the corporation.

RAPID PRINTING TELEGRAPH—It is announced that Wilhelm von Siemens, of Siemens & Halske Company, Berlin, exhibited on November 26, before an audience of postal and telegraph experts, a new telegraphic apparatus on which he and Dr. Franke, Dr. Thomas and Dr. Ehrhardt have been working for several years. Perforated ribbon paper is used in the apparatus, and the experiment showed that 2,000 words a minute could be sent over long distances. The message is received on a strip of sensitized paper, which emerges with the letters fully developed.

WANTS $500,000 DAMAGES—An action to compel the payment of damages said to approximate $500,000 has been brought by the Hudson River Water Power Company against the United Traction Company, of Albany. The plaintiff company supplies the defendant with power for the operation of its roads in Albany and Troy, and it is alleged was unable to secure payment for power supplied when due. After repeated demands the power company threatened to cut off the power at once. The traction company was then compelled to make a new contract at a much higher rate, calling for an extra expenditure of $150,000. Now the power company sues for damages, yet to be computed, for the breaking of the original contract.

BIG DAMAGES TO ALUMINUM COMPANY—Last month the United States Court of Appeals in New York rendered a decision in favor of the Cowles Electric Smelting and Aluminum Company, of Cleveland, against the Pittsburg Reduction Company, of Niagara Falls, N. Y., for infringements of patents since 1892. The decision involved $2,900,000. The Pittsburg Reduction Company has made a compromise settlement by the payment of a large sum of money. The payment covers the damages of infringement for ten years and also royalties for the manufacture of pure aluminum under a special license granted by the Cowles company. This means that the Pittsburg Reduction Company will continue the operation of its extensive aluminum plant at Niagara Falls, and the Cowles plant at Lockport will make alloys.

CHICAGO MUNICIPAL LIGHT—Mayor Harrison, of Chicago, Ill., has declared that the city would enter the electric lighting field at once in competition with the gas and electric companies. The attempt to enter the field by selling to corporations and private individuals electric current made in the municipal plants, it is expected, will result in an appeal to the courts by the big lighting corporations. This, Mayor Harrison declares, is what the city would invite, as it will determine its right to deal in public necessities. "It is just as well to meet this matter at once," said Mayor Harrison. "The earlier we enter the field the earlier we will be prepared to take advantage of the development of the power at the mouth of the great drainage channel connecting the waters of Lake Michigan and the Mississippi river."

REDUCES STREET CAR FARES—Directors of the Philadelphia Rapid Transit Company are seriously considering an entirely new feature in the present fare system—namely, the sale of tickets either six for twenty-five cents or twenty-five for $1. The tickets, it is said, will be put on sale early next year. By selling tickets either six for twenty-five cents or twenty-five for $1, it is said the company will gain the free use of several millions of dollars every year, and just at this time, when many millions are needed for constructing the Market street subway and elevated road, this money would be doubly welcome. The company is carrying daily approximately 1,000,000 passengers. Directors of the company are favorably impressed with the ticket idea, and they figure that fully $1,000,000 worth of tickets will be sold every month.

LIGHTING AND TRACTION COMBINE—The stockholders of the Utah Light and Power Company and the Consolidated Railway and Power Company will meet December 15 and 16 to decide whether or not the two companies will consolidate. If the consolidation is decided upon it will be effected by January 1. It is believed that the new corporation will be capitalized for about $7,000,000 or more. The authorized capital stock of the power company is $3,500,000 and the issued stock is a little over $3,000,000, with the bond issue about the same. The railway company is similarly bonded and capitalized. It is probable that a new company will be organized with a capital at least as large as the two combined, taking over the other two organizations. A new bond issue may then be put out, secured by a blanket mortgage on all the assets of the consolidated company. It is quite likely that provision will be made for some improvements and that from $200,000 to $300,000 will be spent annually in improvements by the new company. Bonds will probably be issued to cover the cost.

NEW TUNNEL FRANCHISE GRANTED—The Board of Rapid Transit Railroad Commissioners of the city of New York has granted a franchise to the Hudson & Manhattan Railroad Company to run a tunnel under the North river, from Exchange place, Jersey City, to Cortlandt street, Manhattan. The tunnel, which will enter New York city at Cortlandt street, will run to Church street and then form a loop running back through Fulton street to the point where the tunnel enters Manhattan. There will be a spur from the station in Church street, and this spur will connect at Broadway and Dey street with the lower Broadway spur of the rapid transit subway. The franchise gives the company a twenty-five-year grant, with the privilege of two renewals, one at ten and the other at fifteen years, with varying rates of compensation to the city, equivalent to three per cent of the capital invested and of the estimated earnings of the company. Mr. William G. McAdoo is president of the company. Mr. McAdoo is also president of the New York & New Jersey Railroad Company, which has received a franchise to run a tunnel under the North river, entering Manhattan at the foot of Christopher street.

THE CHELSEA, LONDON, ENGLAND, POWER STATION—The electrical and steam equipment for the huge power station now under construction at Chelsea, London, S. W., for the purpose of generating current to operate the extensive system of underground and surface lines in and around the British metropolis, in which Charles T. Yerkes is primarily interested, has been announced. The initial capacity will be no less than 75,000 horsepower. There will be ten turbines of 7,500-horse-power capacity each. The generators will have a normal rating of 5,500 kilowatts. The boiler equipment will be of Babcock & Wilcox build. There will be eighty-four units of 520-horse-power capacity each. The cost of the power-house will be about $6,250,000. The motors—for each of the 480 cars to be used on all the lines—will aggregate 500 horse-power. The cars will be built in England. The Underground Electric Railways Company, of London, Limited, has been incorporated under the British Limited Liabilities Act for the purpose of constructing and operating the lines. Charles T. Yerkes is chairman of the company. The other American directors are James A. Blair, of the Wall street banking house of Blair & Company; James Speyer, of Speyer & Company; L. F. Loree, president of the Baltimore & Ohio Railroad; T. Jefferson Coolidge, Jr., president of the Old Colony Trust Company, of Boston; James H. Hyde, of the Equitable Life Assurance Society of New York, and Robert H. McCurdy, of the Mutual Life Insurance Company of New York. To convert the Metropolitan District Railway from steam to electricity and to construct and take over the various other lines in and around London in which the Underground company is interested no less a sum than $85,000,000 will be expended, half of which will be American capital.

PERSONAL MENTION.

LORD KELVIN received the degree of D. Sc. from the University of Wales on the occasion of the Court of November 13, 1903.

MR. J. J. LOWTHIAN, representative of Baker & Company, gold, silver and platinum refiners, was a visitor to Chicago last week.

DR. HENRY S. PRITCHETT, president of the Massachusetts Institute of Technology, has resumed his official duties after a brief foreign trip.

MR. HOWARD S. KNOWLTON, formerly with Stone & Webster, Boston, Mass., has joined the engineering department of the Colorado Telephone Company, at Denver, Col.

MR. W. W. BOSTWICK, JR., formerly with the Lambert Schmidt Telephone Manufacturing Company, has been appointed New York manager for the Couch & Seeley Company, of Boston, Mass.

MR. R. A. DARLING, instructor in mechanical engineering at the University of Nevada, has been granted a year's leave of absence in order to take up advanced work at the Leland Stanford, Jr., University.

MR. CYRUS O. BAKER, JR., the platinum importer and refiner, who possesses a very large circle of friends in the electrical fraternity, is again at his office in New York city after a severe illness of several weeks.

MR. WALTER M. SMITH, junior engineer in the United States Engineering Office, Portland, Me., has been transferred to the United States Engineer's Office at Charleston, S. C., where he was to report for duty December 1.

MR. ROBERT McF. DOBLE, consulting engineer, has returned to San Francisco, Cal., after an absence of several months in Mexico, having completed the installation of the hydroelectric power plant of the Guanajuato Power and Electric Company.

MR. A. W. HUTCHINS, president of the Ballou-Hutchins Electric Company, Providence, R. I., manufacturers of automatic time switches, was a New York visitor last week. The demand for the new product of this company is meeting with much favor in electric lighting circles.

PROFESSOR S. HOMER WOODBRIDGE, formerly associated with Stone & Webster, electrical engineers, in the S. Homer Woodbridge Company, has severed his connection with the company, and is now associated with Mr. Andrew D. Fuller, consulting sanitary engineer, Boston, Mass.

MR. LAMAR LYNDON, on Tuesday evening, December 1, delivered his second lecture on "The Storage Battery; Its Practical Operation, Deterioration and Management," at the Automobile Club of America, 753 Fifth avenue, New York city. This was illustrated with lantern slides and experimental demonstrations.

MR. HENRY L. SHIPPY, treasurer of the John A. Roebling's Sons Company, of New York, has been confined to his room for several weeks past with a severe illness and was threatened with an attack of appendicitis. His host of friends in this country and abroad will be very glad to learn that he is now convalescent and soon expects to be at his office again.

MR. GEORGE E. BERNECKER, manager of the exchange of the Cumberland Telephone Company, Jeffersonville, Ind., on December 1 took charge of the exchange in New Albany, Ind., and will hereafter manage both exchanges. Mr. Horace Gooch, who has been manager of the New Albany exchange, will go to Texas, where he will be in charge of an independent telephone system.

MR. CHARLES V. WESTON, of Chicago, has severed his connection with the Chicago Engineering and Construction Company, of which he was president. His duties as chief engineer of the South Side Elevated Railroad Company, which is about to build extensions, naturally calls for much of his time along with other consulting practice which he enjoys.

MR. THOMAS L. MILLER, M. I. C. E., of Manchester, England, has arranged with Mr. C. H. Wordingham, M. I. C. E., of the same place, to take over his consulting electrical engineering practice, as Mr. Wordingham has been appointed to the post of electrical engineer-in-chief of the English Navy. Mr. Miller will continue Mr. Wordingham's practice from 190 Brazennose street, Manchester, Tower Building, North Water street, Liverpool, and at 61 Old Broad street, London, E. C., under the name of Miller & Collins. In order to cope with the great amount of work, Mr. Miller has arranged to take into partnership Mr. H. W. Wilson, who has been engineer to the Lancaster branch of the British Thomson-Houston Company, Limited.

MR. CHARLES T. YERKES, the head of the syndicate which is equipping London, England, with a series of surface and underground electric lines, arrived last week from London, where he has been for some time promoting the interests of his company. The Metropolitan District Railway is being converted from steam to electricity, and the Baker Street & Waterloo Railway, which was acquired from the London & Globe Finance Company, is being extended at both ends. The Great Northern, Brompton & Piccadilly Railway has been acquired, and plans are under way to control the Charing Cross, Euston & Hampton Railway. The underground lines will also include the London United Tramways. It is stated that the syndicate is spending some $85,000,000 in its operations, and that about $40,000,000 of this is American capital. The greater part of the work is expected to be finished by April of next year.

ELECTRIC LIGHTING.

DETROIT, MICH.—Wingham has voted $20,000 to buy the electric light plant.

CAZENOVIA, N. Y.—The electric light wires in Cazenovia are being laid underground.

DOYLESTOWN, PA.—It is stated that Schuylkill Haven's electric light plant will probably be enlarged.

SIOUX CITY, IOWA—At a recent election the Eagle Grove people voted a franchise to the Eagle Grove Electric Light and Heating Company.

BOSTON, MASS.—Foundations are being put in for a $40,000 electric light plant to be built at Mansfield. The contracts for the work have been given to a Providence firm of builders.

WORCESTER, MASS.—The directors of the Ware Electric Company have decided to increase the capacity of the plant at an outlay of from $20,000 to $30,000. A new building will be erected, fifty by eighty-two feet, and practically fireproof.

MEYERSDALE, PA.—At a meeting of the borough council a resolution was adopted, authorizing the light committee to draw up plans and specifications and advertise for bids for a suitable electric light plant, to be owned and operated by the borough.

VERSAILLES, MO.—The election held here for the purpose of voting on a proposition to issue bonds to the amount of $10,000 for the purpose of erecting an electric light plant resulted in favor of bonding the city for that amount. Work will be begun on the plant at once.

GREENFIELD, MASS.—Work on the power-house for the Electric Light and Power Company has commenced. The building will be of stone, 150 by 60 feet. There are to be three boilers, furnishing altogether 750 horse-power, and two engines, one of 300 and one of 500 horse-power.

READING, PA.—It is reported on good authority that 100 representative men, each paying $250, are about to form an organization to supply the borough with an electric light plant, with a prospect, however, that the borough will become the purchaser of the plant after such time when the funded debt of the borough is reduced sufficiently.

BEDFORD, MASS.—The special committee appointed at the November town meeting to investigate the subject of electric street lighting made its report at the adjourned meeting and recommended that electric lights be substituted for the present system of street lighting by oil lamps. Without discussion it was voted unanimously to authorize the board of selectmen to contract for electric lights for the three miles of streets within the village limits. Current will be furnished by the Lexington Electric Light Company, which will extend its system to this place. Work upon the new line will be begun at once. This company will also furnish current for commercial lighting, and many of the village residents will use electricity for lighting their residences and places of business.

TELEPHONE AND TELEGRAPH.

BRIDGETON, PA.—The Interstate Telephone Company has placed its new system in operation.

WEST UNION, IOWA—The Iowa Telephone Company will build another line west from West Union.

PHILADELPHIA, PA.—The Standard Telephone Company will extend its line from Doylestown to Lansdale.

MONTGOMERY, ALA.—The American Telephone and Telegraph Company has filed articles of incorporation with a capital of $100,000.

WATERLOO, IOWA—The Cedar Valley Telephone Company plans to rebuild its local exchange, installing either a central energy or an automatic system.

BOONE, IOWA—A large telephone merger has been completed by the purchase of the Ogden Telephone Company's system at Ogden by the Boone County Telephone Company.

CINCINNATI, OHIO—The local Bell telephone company's name has been changed from the City & Suburban Telegraph Association to the Cincinnati & Suburban Telephone Company.

ST. PAUL, MINN.—Red River Telephone Company, of Moorhead, has been incorporated with a capital of $50,000. The incorporators are P. H. Lamb, L. H. Baker and Leslie Wetter, all of Moorhead.

YORK, PA.—The Codorus Telephone Company has been organized to build a line from Spring Grove to Sticks. Eli Sterner has been elected president; J. C. Brodbeck, secretary, and S. B. Brodbeck, treasurer of the company.

POUGHKEEPSIE, N. Y.—The State Line Telephone Company has increased its capitalization from $1,000,000 to $10,000,000. The Dutchess County Telephone Company is affiliated with this company, and the local line will be placed all over Dutchess County.

BUFFALO, N. Y.—The certificate of incorporation of the Eden Telephone Company has been filed in the office of the county clerk. The company is capitalized at $3,000. The directors are Duran and Byrena Palmerton, G. C. and M. A. Bartoo, and others. The company purposes to connect Eden, North Collins, Hamburg and other places with Buffalo and each other by telephone.

OAKVILLE, IOWA—The Oakville Telephone Exchange Company has completed the work of changing and operating in its new office. It will start out with nearly four hundred subscribers, which will be added to as soon as it can place the telephones. The new company consists of E. B. Conkling, president; F. C. Edwards, vice-president; S. R. Gawthrop, secretary and general manager, and J. C. Thomson, treasurer.

BAY CITY, MICH.—The Northeastern Telegraph and Telephone Company has completed its new telephone lines along the northern division of the Michigan Central to beyond Gaylord, having nearly reached Wolverine. Three metallic circuits are being constructed, although only two will be carried as far as Mackinaw City. The company has three circuits to Tawas and two through to Alpena. The Bay City-Mackinac lines branch off at Standish.

SIOUX CITY, IOWA—Sioux City's new telephone company, the Sioux City Telephone Company, has announced that it will spend $350,000 to establish its plant here. Its exchange building will be a three-story fireproof structure; its equipment will be of the latest type. The poles will be set this winter, and wires and cables will be strung before spring. The underground work will not be started until April, when all the wires which the company will have between Third and Seventh streets will be placed underground. Already almost 1,000 subscribers for two years have been secured.

TROY, N. Y.—The Port Henry Telephone Company has been organized with a capital of $15,000, $6,000 of which has already been subscribed. The following officers have been elected: president, John R. Sherman; vice-president, Nestor Berman; secretary, S. F. Lane; treasurer, P. C. Kelley; directors, L. F. Sprague, H. F. Greene, George S. Kidder, Michael Moore and Aaron H. Weston. Work on the line will be begun at once. The new line will connect with Willsboro and through independent lines to Albany. A cable will be laid across the lake, giving connections with Addison County, in Vermont. It is expected that connection with Plattsburgh will be made after the independent company in that city begins to operate.

ALTOONA, PA.—It has been announced at the offices of the Pennsylvania Railroad Company here that work on the new trunk telephone line between Philadelphia and Pittsburg will begin immediately. Two lines will be constructed, for the exclusive use of the officials of the company and other employés. They will supplant a through wire leased from the Bell Telephone Company. The estimated cost is $75,000, exclusive of the poles. The wires will be strung on the new poles recently erected for the Postal Telegraph Company by the Pennsylvania. They will be of the heaviest copper, and it is said that the line will be the most expensive ever built. The Pennsylvania will maintain its own telephone wires between division points. Telephones are said to be a much cheaper method of transmitting certain messages than the telegraph, requiring fewer messages.

PORT JEFFERSON, L. I.—The North Shore Telephone Company, with a capital of $7,500, has been organized with the following directors: Frank H. Tuthill, of Rocky Point; W. A. Davis, of Mount Sinai; Postmaster C. A. Squires, of Echo; J. H. Davis, H. T. Bayles, John E. Overton, Charles V. Platt and Ralph J. Hawkins, of Port Jefferson, and Thomas N. Bayles, of Stony Brook. It is proposed to run a local line from Smithtown to Wading River, with a central at Port Jefferson, and give an unlimited service to all subscribers, except business places, at $10 a year. Business places will be charged $15. The new company anticipates starting with 200 connections, and is already securing contracts for service. The company is not yet incorporated, nor has it secured a franchise, but it has good assurance that these matters will go through all right. The new company will give an all-night service and put telephones in all public places where it will be of any advantage to the subscribers.

ELECTRIC RAILWAYS.

WATERLOO, IOWA—It is said that Des Moines parties, representing Cincinnati capitalists, have in view an electric railway running from Britt through Crystal Lake, Buffalo Center, Elmore, and terminating at Fairmont, Minn.

WILLIAMSPORT, PA.—It is proposed to connect Wellsboro, Tioga County, Pa., with Elmira, N. Y., by trolley. The proposed road will be about fifty-five miles long, and it is estimated will cost from $15,000 to $30,000 a mile. It is also proposed to build a spur connecting Covington and Blossburg with Tioga.

MANSFIELD, OHIO—The Mansfield & Eastern Traction Company, projecting a trolley line between this city and Ashland, has elected the following officers: president, David Morison, Cleveland; vice-president, Robert B. McCrory; general manager, Charles Meiley; secretary, James W. Galbraith; treasurer, James W. Maguire. All of the officers but the president are residents of this city.

ALBANY, N. Y.—The Court of Appeals has sustained the action of the State Board of Railroad Commissioners in granting permission to the New York & Port Chester Railroad Company to construct a third-rail electric road twenty-one miles long from Willis avenue and One Hundred and Thirty-second street, through Fordham, Williamsbridge, Mount Vernon and New Rochelle to Port Chester.

COLUMBUS, OHIO—The Barnesville & Woodsfield Electric Railway Company has been incorporated by George E. Hilles, E. T. Petty, J. W. Chappell, T. J. Buchanan, J. W. Laughlin and W. E. Sharps. Capital stock, $25,000. It will build an electric railway from Bethesda, in Belmont County, to Woodsfield, Monroe County, Somerton, Malaga and Miltonsburg, and will supply heat, light and power to those towns.

FREDERICK, MD.—The county commissioners have passed an order granting to the Meyersville & Catoctin Railway Company, the right to construct a railway across county roads at certain points at and above Meyersville. This privilege was asked by the company, with a view to the construction of a link connecting the

electric railways in this and Washington counties. It is granted upon certain conditions respecting the maintenance of safe and easy crossings.

FAYETTEVILLE, W. VA.—The electric railroad up Loop creek is said to be assured, the contract for the building of the first five miles of the new line having been let. Work at Thurmond will be begun at once. The rest of the line through to Kilsythe, a distance of about twelve miles, from Thurmond will be let to contract also within a short time. The new road will be standard gauge and will be both a passenger and freight line. The part let to contract is from Glen Jean to Thurmond.

FREEPORT, ILL.—The Freeport-Dixon Electric Railroad Company has been granted a charter by the secretary of state, the capital stock of the company being given as $50,000. The company will construct a road from Freeport to South Freeport, to connect with the Great Western Railroad, and from there it will extend to Forreston and Polo, in Ogle County, and thence to Dixon, in Lee County. All preliminary work will be done this fall, and active construction will commence early in the spring.

WAPAKONETA, OHIO—The Sandusky Southwestern Railway Company, of this city, has filed a deed of trust with the company recorder to the Cleveland Trust Company, for the sum of $2,000,000, covering all its rights of way, franchises, real estate and property in Auglaize, Allen, Logan and Hardin counties. This mortgage is given to secure a bond issue of $1,000 bonds, payable twenty years from November 1, 1903, with five per cent interest. The road, as planned, is seventy miles in length, extending from this city to Kepton, and from Lima to Bellefontaine.

PIERRE, S. D.—Articles of incorporation have been filed with the secretary of state for the Black Hills & Wyoming Railway Company, with headquarters at Rapid City and a capital of $700,000. The line is to be thirty-five miles in length, and will connect with the Elkhorn Road at Rapid City, and the Burlington & Missouri River at Mystic, and will be all in Pennington County. The directors of the road are Charles D. Crouch, Francis Sieberling, Frank A. Sieberling and Fred E. Smith, of Akron, Ohio; E. F. Hurlburt and Jacob S. Gantz, of Rapid City.

YORKTOWN, VA.—The extension of the lines of the Newport News Railway and Electric Company to Yorktown is about to be made. A survey of the projected route has been completed. The idea of the company is to cross the eastern end of the peninsula, bridge Back river near its upper end, and gain access into York County, through Poquoson, thereby tapping the richest section of Tidewater, and affording transportation facilities to a country entirely devoid of anything of the kind. Both mail and express matter will be afforded much better schedules, and as the resources develop, the road will be pushed through Gloucester County to West Point, gaining the rich trade of the tier of counties lying between the York and Rappahannock.

PROVIDENCE, R. I.—The Westerly & Hopkinton Street Railway has secured a controlling interest in the Pawcatuck Valley Street Railway Company. The following board of directors has been elected by the new owners: Frank P. Sheldon, of Providence; J. O. Sweet, of Jewett City, Ct.; F. G. Jillson, of Woonsocket; Nathan D. Lewis, of West Kensington; George W. Mansfield, of Boston, and William Hoxsey and John Champlin, of Westerly. These directors have elected the following officers: president, William Hoxsey; vice-president, Frank P. Sheldon; secretary and treasurer, J. O. Sweet. The same company is said to be also negotiating for the controlling interest in the Westerly Gas and Electric Light Company. The company has opened an office in Westerly, and the management expects to build the road through from Westerly to Hopkinton.

INDIANAPOLIS, IND.—Articles of incorporation have been filed for the Indianapolis, Newcastle & Winchester Traction Company, with a capital stock of $100,000, divided into shares of $100 each. The officers of the new company are: president, Benjamin Koons, of Mooreland; vice-president, E. L. Watson, of Winchester; secretary, Charles S. Hernley, of Newcastle; treasurer, Daniel E. Storms, of La Fayette. The directors and incorporators are composed of these officers and D. S. Wiggins and J. T. Burrows, of Losantville; Union B. Hunt, of Winchester; A. N. Fisher, of this city; Robert G. Hunt, of Modoc. The work of surveying the line has already begun, under charge of A. N. Fisher, who will also have charge of obtaining right of way. The survey has begun through Brightwood, and it is announced that it will be pushed rapidly. A part of the right of way has been obtained. The line for the road as at present planned will be about seventy-five miles in length, leading from this city to Winchester, Ind., by way of Newcastle. Among other towns that it is planned to pass through are: Modoc, Cadiz, Kennard, Shirley, Wilkinson, Wilcox, Maxwell, Mount Comfort and Mohawk. In addition to the traction business it is proposed to furnish these towns with light and power. The principal place of business of the company will be at Newcastle.

ELECTRICAL SECURITIES.

Probably the most encouraging feature of last week in financial quarters was the improvement in the money market outlook. Notwithstanding this improvement, rates have held firm, with nine per cent the highest for call funds, and five and one-half and six per cent for time loans. It is prophesied that no further large drains for funds will be made upon New York for the interior. The banks gained in exchange to an amount estimated at from $1,200,000 to $1,500,000. This, following last week's gain from the same source, is accepted as an indication that the demand is practically over.

It is reported that there is a better activity in pig iron as well as in finished iron products. The concession in rates by the railroads on export business has stimulated that industry, and it is announced that the management of the steel corporation has already made large foreign contracts and expects to make even more, to offset the decreased home consumption.

It is predicted that there will be an early breaking away of the railroad list from the adverse influence of the industrials. This sentiment has been strengthened by last week's readjustment in the value of the latter securities, and the small effect this had on prices for rails. Several of the largest railroad companies have but recently made splendid annual reports and show that, notwithstanding the settling down of trade for the past six months, they have been carrying a profitable traffic; and there is every indication that this condition will continue.

ELECTRICAL SECURITIES FOR THE WEEK ENDING NOVEMBER 28.

New York:	*Closing.*
Brooklyn Rapid Transit	39¾
Consolidated Gas	178
General Electric	154½
Kings County Electric	175
Manhattan Elevated	139¼
Metropolitan Street Railway	116⅝
New York & New Jersey Telephone	145
Westinghouse Manufacturing Company	170

The Kings County Electric Company is paying its regular quarterly dividend of 2 per cent.

Boston:	*Closing.*
American Telephone and Telegraph	125
Edison Electric Illuminating	240
Massachusetts Electric	76
New England Telephone	120
Western Telephone and Telegraph preferred	80

Philadelphia:	*Closing.*
Electric Company of America	7⅜
Electric Storage Battery common	46
Electric Storage Battery preferred	46
Philadelphia Electric	5⅞
Union Traction	43⅞
United Gas Improvement	78¼

Chicago:	*Closing.*
Chicago Telephone	124
Chicago Edison	142
Metropolitan Elevated preferred	51
National Carbon common	17½
National Carbon preferred	86¼
Union Traction common	5
Union Traction preferred	29

The report of the Northwestern Elevated Railroad Company for the year ended June 30, 1903, shows gross earnings of $1,642,456, and expenses of $517,441, leaving net earnings of $1,125,015. Charges, taxes, etc., amounted to $941,605, thus leaving a surplus of $183,410, as compared with a surplus of $151,631 the previous year, an increase of $31,779.

South Side Elevated directors have declared the regular quarterly dividend of one per cent, payable December 31. Books close December 19 and reopen January 2.

INDUSTRIAL ITEMS.

THE UNION SWITCH AND SIGNAL COMPANY, Swissvale, Pa., has ready for distribution its catalogue, illustrative and descriptive of interlocking and signaling devices, which will be sent on request.

THE BALL & WOOD COMPANY, builder of improved automatic cutoff engines, has opened a Chicago office at 1247 Marquette Building. The New York office of the company is 17 Battery place, New York city.

THE BENBOW COMPANY, New York city, N. Y., is sending out descriptive circulars showing the application of the "Benbow adjustable swinging telephone bracket," which it manufactures. These circulars will be sent on request.

ALEXANDER WRIGHT & COMPANY, Westminster, England, will send on request a descriptive circular detailing the construction and use of the Simmance-Abady patent "Flicker" photometer. This is a novel and efficient apparatus for testing the illuminating power of gas, electric or oil lights of any color or intensity.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., reports that during the past few weeks it has done an exceptionally good business in Nernst lamps and Westinghouse wattmeters. The company is carrying a large and complete stock of both of these lines, and is in position to make immediate shipment on orders.

THE ELECTRIC VEHICLE EQUIPMENT COMPANY, Philadelphia, Pa., announces that on November 30 it will discontinue its garage at 210 North Broad street, Philadelphia, and devote its entire attention to the manufacture of commercial vehicles and tractor trucks at its factory, Twentieth street and Montgomery avenue.

THE AMERICAN CONDUIT MANUFACTURING COMPANY, 413 Grant street, Pittsburg, Pa., announces a new price list and table of discounts on "American" iron-armored conduit. The main office has been moved from New Kensington to Pittsburg, Pa., and improvements have been completed at the factory at New Kensington.

THE WIRT MANUFACTURING COMPANY, Philadelphia, Pa., is sending out several descriptive bulletins which illustrate dynamo field rheostats, battery charging apparatus, and the Wirt dynamo brush. A novel souvenir which the Wirt company is distributing to its patrons is called the "Sensitive Fish." This is a unique article and affords much amusement.

THE A. L. DYKE AUTOMOBILE SUPPLY COMPANY, St. Louis, Mo., announces that it has completed arrangements to expand its business, by acquiring new capital and employing several salesmen to cover new territory. Several St. Louis men are now associated with Mr. Dyke, the president of the company. These are Messrs. F. H. Britton, Roy F. Britton and Charles Peters, who will become directors of the new company.

THE F. BISSELL COMPANY, Toledo, Ohio, is distributing its perpetual catalogue descriptive of motor starters and controllers. This perpetual catalogue is arranged for binding into those sheets which have already been distributed to be supplemented by future editions. This catalogue lists a very extensive line of electrical apparatus and should be in the hands of any one interested in this class of machinery.

THE EWING-MERKLE ELECTRIC COMPANY, St. Louis, Mo., will carry a full line of the new "Imperial" lamps made by the Bryan-Marsh Company. The Ewing-Merkle company is preparing a booklet giving full particulars of this new lamp, which burns out at the eighty per cent line—that is, when it drops to eighty per cent of the initial candle-power. This booklet will be sent upon request to the company.

THE STANDARD STEAM SPECIALTY COMPANY, New York city, manufacturer of "Utility" steam specialties, is calling attention to the "Utility" exhaust-heating apparatus. This, the maker states, works well with all systems, is economical, durable, self-cleaning, and will give good service for an indefinitely long period. This apparatus has been installed in a number of prominent buildings throughout the United States.

THE GOULD STORAGE BATTERY COMPANY, New York city, N. Y., has recently secured a contract from the New York, New Haven & Hartford Railroad Company to install at the Bristol, Ct., and New Britain, Ct., stations, for lighting purposes, an installation of storage batteries of fifty-five cells each. The company also recently received a contract from the Narragansett Electric Lighting Company, Providence, R. I., to install positive plates with an aggregate capacity of 320,000 ampere-hours, in place of those of the original installation.

THE HESS MANUFACTURING COMPANY, Fifteenth and Chestnut streets, Philadelphia, Pa., has issued a handsome catalogue descriptive of milling machines and cutters for large output. This company makes a specialty of adapting electric motors for direct-driving, and will be pleased to receive specifications for large and small work. The company furnishes its machines with a special form of cutter for fast feeding and heavy milling. The catalogue will be sent to any one upon request, and should be of great interest to those engaged in this class of work.

THE WOODWARD GOVERNOR COMPANY, 658-660 Race street, Rockford, Ill., has published a handsome catalogue describing and illustrating its governors for water-wheels. These are of the compensating type in two models for electric light, power, and railway service, and the standard type, for factory and mill service. The illustrations are definite and well worked up and a concise description is given as to mechanism and operation. The company has doubled the floor space of its shops within the past year, and has added many new machines and special tools to ensure the exact duplication of parts.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, suffered the partial loss of its shop No. 2 by fire on Thursday evening, November 26. This shop consisted of the plant containing the punch presses, annealing ovens and forges. The loss is fully covered by insurance, and the tools were not seriously damaged. The company has already erected temporary sheds over its tools, and there will be no delay in the completion of orders it has on hand or those that it may receive. The company will at once begin the reconstruction of shop No. 2 on a scale larger than the original structure.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, Ill., manufacturer of automatic telephones and automatic telephone installations under the Strowger patents, is distributing a booklet, on the front cover of which is endorsed, "In Witness Whereof We Hereto Have Set Our Hands and Seals," the cover being further illuminated by an embossed representation of the Automatic Electric Company's desk apparatus and a seal pen and bottle of ink. This booklet contains the signed testimonials of a great number of the subscribers of the Home Telephone Company, of Dayton, Ohio, which is equipped entirely with the Automatic telephone system, installed by the Automatic Electric Company.

THE AMERICAN STEEL AND WIRE COMPANY, Chicago, Ill., has issued a new catalogue on its wire rope and fittings. This is dated November, 1903, and cancels the issue of April, 1900. In this catalogue are described several types of wire rope for haulage, transmission and standing rope construction, running rigging construction, hoisting rope construction, special flexible hoisting rope and tiller rope construction, and a chapter of suggestions to users of wire rope, and instructions and working data on the foregoing types of rope is added. Directions are given for splicing wire rope, and the charges of labor for splicing endless rope. There are also illustrated and described cast-steel flat rope, and various forms of combination rope and metal auxiliaries.

THE COLUMBUS STORAGE BATTERY COMPANY, 97 North Third street, Columbus, Ohio, manufacturer of the Columbus Storage battery, has issued a new catalogue which, besides listing its various types of cells, also contains a short treatise on the use and care of storage batteries. This is the company's third annual catalogue to the electrical trade. The company has installed a number of batteries in private lighting plants during the past year, and is thus enabled to give a prospective customer detailed information in regard to his particular installation. The company states that its batteries have found a good market in the telephone trade, and it has made a number of such installations during the year. This catalogue will be sent to any one interested upon request.